Simple Wire Inlay; Stunning Results

Earlex Steam System

# POPULAR WOODWORKING MAGAZINE

June 2015 ■ #218

# Sideboard Fit for Tea

## Asian Inspiration & High-End Handwork

popularwoodworking.com

Design Details: A Matter of Gravity

Compound Leg Angles; No Math

'Floating' Table Tests Your Band Saw Skills

# Grizzly Industrial®

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## 10" HYBRID TABLE SAW
### with RIVING KNIFE

- Motor: 2 HP, 120V/240V, single-phase, prewired to 120V
- Amps: 15A at 120V, 7.5A at 240V
- Precision-ground cast iron table with wings measures: 40½" W x 27" D
- Table height: 35⅜"
- Footprint: 21" L x 19½" W
- Arbor: ⅝" • Arbor speed: 3450 RPM
- Capacity: 3¼" @ 90°, 2¼" @ 45°
- Rip capacity: 30" right, 15" left
- Overall size: 57¼" W x 35⅜" H x 37½" D
- Approximate shipping weight: 348 lbs.-

New!

FREE 10" CARBIDE-TIPPED BLADE

4" DUST PORT

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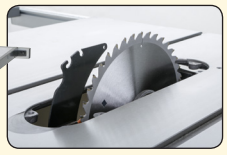
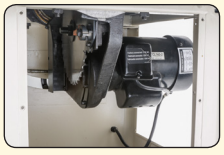
QUICK-RELEASE BLADE GUARD ASSEMBLY





Intertek 3092372

**G0771** ~~$795.00~~ **INTRODUCTORY PRICE $675.00** $99 shipping

## 10" CONTRACTOR-STYLE TABLE SAW
### with RIVING KNIFE

- Motor: 1½ HP, 110V/220V, single-phase, prewired to 110V, 11.5A/5.7A
- Precision-ground cast iron table with wings
- Table size: 25¼" x 40" • Arbor: 5/8"
- Arbor speed: 4000 RPM
- Capacity: 3⅛" @ 90°, 2¼" @ 45°
- Rip capacity: 30" R, 12" L
- Approx. shipping weight: 208 lbs.

CSA C 175370 US

FREE 10" CARBIDE-TIPPED BLADE

**G0732** ~~$795.00~~ **SALE $650.00** $99 shipping

## 10" LEFT-TILTING TABLE SAWS
### with RIVING KNIFE

- Motor: 3 HP or 5 HP, 240V, single-phase
- Precision-ground cast iron table size with wings: 27" x 48"
- Arbor: ⅝"
- Cutting capacity: 25⅝" R, 8" L
- Max. depth of cut: 3" @ 90°, 2⅛" @ 45°
- Approx. shipping weight: 550 lbs.

See our website for Reviews & Awards grizzly.com

CSA C 177335 US

**G1023RLW** 3 HP ~~$1375.00~~ **SALE $1295.00**

**G1023RLWX** 5 HP ~~$1395.00~~ **SALE $1325.00** $150 shipping

## 10" CABINET TABLE SAW

See our website for Reviews & Awards grizzly.com

Good Tools Approved TOP VALUE 2009

- Motor: 3 HP, 220V, single-phase
- Precision-ground cast iron table
- Table size with extension: 27" x 74¾"
- Arbor: ⅝" • Arbor speed: 4300 RPM
- Capacity: 3⅛" @ 90°, 2⅜" @ 45°
- Rip capacity: 50" R, 12" L
- Max. dado width: 13/16"
- Approx. shipping weight: 557 lbs.

CSA C 232857 US

3 HP LEESON® MOTOR!

**G0691** ~~$1595.00~~ **SALE $1495.00** $150 shipping

## 6" JOINTERS

- Motor: 1 HP, 120V, single-phase, 13A (G0452) or 1½ HP, 120V/240V, single-phase, 15A/7.5A, prewired 120V (G0452Z)
- Max. stock width: 6" • Max. depth of cut: ⅛"
- Max. rabbeting capacity: ½"
- Table size: 7½" x 46"
- Cutterhead diameter: 2½", Speed: 4800 RPM
- Fence adjustment stops at ± 45° & 90°
- Approx. shipping weight: 268 lbs.

CSA C 208624 US

BUILT-IN MOBILE BASE!

4 KNIFE CUTTERHEAD
**G0452** ~~$550.00~~ **SALE $525.00**

SPIRAL CUTTERHEAD
**G0452Z** ~~$850.00~~ **SALE $825.00**

FREE PAIR OF SAFETY PUSH BLOCKS!

$79 shipping

## 8" JOINTERS

- Motor: 3 HP, 240V, single-phase, TEFC, 3450 RPM
- Precision-ground cast iron table size: 9" x 72½"
- Max. depth of cut: ⅛"
- Max. rabbeting depth: ½"
- Cutterhead dia.: 3"
- Cutterhead speed: 4800 RPM
- Cuts per minute: 20,000 (G0656), 21,400 (G0656X)
- Approx. shipping weight: 522 lbs.

CSA C 208624 US

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BUILT-IN MOBILE BASE!

4 KNIFE CUTTERHEAD
**G0656** ~~$845.00~~ **SALE $825.00**

SPIRAL CUTTERHEAD
**G0656X** ~~$1275.00~~ **SALE $1225.00**

$150 shipping

## 12" JOINTER/PLANER
### with SPIRAL CUTTERHEAD

Fine Woodworking Magazine BEST OVERALL

See our website for Reviews & Awards grizzly.com

- Motor: 5 HP, 220V, single-phase
- Jointer table size: 14" x 59½"
- Cutterhead dia.: 3⅛"
- Cutterhead speed: 5034 RPM
- Max. jointer depth of cut: ⅛"
- Max. width of cut: 12"
- Planer feed rate: 22 FPM
- Max. planer depth of cut: ⅛"
- Max. planer cutting height: 8"
- Planer table size: 12¼" x 23⅛"
- Approx. shipping weight: 704 lbs.

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# SUMMER SALE
## April 15–July 31

## PLANER/MOULDER with STAND

- Motor: 2 HP, 230V, single-phase, 10.8A, 3450 RPM
- Precision-ground cast iron table measures 14⅛" x 10" x 7/16"
- Max. planing width: 7"
- Max. planing height: 7½"
- Cuts per minute: 14,000
- 2 HSS knives
- Approx. shipping weight: 324 lbs.

SHOP FOX

CSA C US 177335

**W1812** ~~$1650.00~~ SALE **$1525.00**

$99 shipping

## 15" PLANERS

- Motor: 3 HP, 240V, single-phase, 15A
- Precision-ground cast iron table size: 15" x 20"
- Min. stock thickness: 3/16"
- Min. stock length: 8"
- Max. cutting depth: ⅛"
- Feed rate: 16 & 30 FPM
- Cutterhead speed: 4800 RPM
- Approx. shipping weight: 666 lbs.

CSA C US 208624

PRECISION-GROUND CAST IRON BED AND INFEED & OUTFEED TABLES

BUILT-IN MOBILE BASE!

3 KNIFE CUTTERHEAD
**G0453P** ~~$1150.00~~ SALE **$1125.00**

SPIRAL CUTTERHEAD
**G0453PX** ~~$1795.00~~ SALE **$1750.00**

$150 shipping

## 20" PLANERS

- Motor: 5 HP, 240V, single-phase
- Max. cutting width: 20" • Min. stock length: 8"
- Max. cutting depth: ⅛"
- Feed rate: 16 FPM & 20 FPM
- Cutterhead diameter: 3⅛", Speed: 4800 RPM
- Number of knives: 4 HSS
- Table size: 20" x 25¾" (20" x 55½" with extension)
- Overall dimensions: 55½"L x 39½"W x 45⅞"H
- Approx. shipping weight: 932 lbs.

4 KNIFE CUTTERHEAD
**G0454** ~~$1750.00~~ SALE **$1725.00**

SPIRAL CUTTERHEAD
**G0454Z** ~~$2575.00~~ SALE **$2495.00**

BUILT-IN MOBILE BASE!

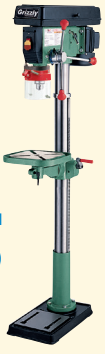
CSA C US 208624

$179 shipping

## 12 SPEED HEAVY-DUTY 14" FLOOR DRILL PRESS

- Motor: ¾ HP, 110V, single-phase • Swing: 14"
- Drill chuck: 1/64"–⅝" • Drilling capacity: ¾" steel
- Spindle taper: MT#2 • Spindle travel: 3¼"
- Speeds: 140, 260, 320, 380, 480, 540, 980, 1160, 1510, 1650, 2180, 3050 RPM • Collar size: 2.595"
- Precision-ground cast iron table
- Table size: 11⅜" square
- Table swing: 360°
- Table tilts: 90° left & right
- Overall height: 64"
- Approx. shipping weight: 171 lbs.

INCLUDES BUILT-IN LIGHT (BULB NOT INCLUDED)




**G7944** ~~$395.00~~ SALE **$355.00**

$79 shipping

## 2 HP DUST COLLECTOR with 2.5 MICRON BAG

- Motor: 2 HP, 240V, single-phase, 3450 RPM, 9A
- 6" inlet w/removable "Y" fitting w/two 4" openings
- Impeller: 12¾" aluminum
- Portable base size: 21¼" x 33½"
- Bag volume: 5.7 cubic feet
- Height (with bags inflated): 78"
- Bag size: 19½" x 33" (2)
- Air suction capacity: 1550 CFM
- Maximum static pressure: 11"
- Standard bag filtration: 2.5 Micron
- Approx. shipping weight: 122 lbs.

CSA C US 247570

FREE! 2-STAGE CYCLONE SEPARATOR W1049 - A $34.25 VALUE

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## 1½ HP CYCLONE DUST COLLECTOR

- Motor: 1½ HP, 110V/220V, single-phase, TEFC, 3450 RPM
- Air suction capacity: 775 CFM
- Static pressure at rated CFM: 1.80"
- Intake port: 6" with included 5" optional port
- Impeller: 13½"
- Height: 68"
- Built-in remote control switch
- Approx. shipping weight: 210 lbs.

FULLY MOBILE WITH BUILT-IN CASTERS

ONLY 68" TALL!

$79 shipping

**G0703P** ~~$850.00~~ SALE **$825.00**

## ULTIMATE 14" BANDSAW

- Motor: 1 HP, 110V/220V, single-phase, TEFC, 11A/5.5A
- Precision-ground cast iron table size: 14" sq.
- Table tilt: 45° R, 15° L
- Cutting capacity/throat: 13½"
- Max. cutting height: 6"
- Blade size: 92½"–93½" L (⅛"–¾" W)
- Blade speeds: 1500 & 3200 FPM
- Approx. shipping weight: 196 lbs.

CSA C US 252923

**G0555P** ONLY **$545.00**

Free! shipping

## 30TH ANNIVERSARY 17" HEAVY-DUTY BANDSAW

- Motor: 2 HP, 110V/220V, single-phase, TEFC, prewired 220V • RPM: 1725
- Amps: 20A at 110V, 10A at 220V
- Precision-ground cast iron table size: 17" x 17" x 1½" thick
- Table tilt: 10° left, 45° right
- Floor-to-table height: 37½"
- Cutting capacity/throat: 16¼" left
- Blade size: 131½" long
- Approx. shipping weight: 342 lbs.

MADE IN AN ISO 9001 FACTORY!

**G0513ANV** ONLY **$875.00**

Free! shipping

## 17" HEAVY-DUTY BANDSAW

- Motor: 2 HP, 110V/220V, prewired to 220V, single-phase, TEFC
- Precision-ground cast iron table size: 17" sq.
- Table tilt: 45° R, 10° L
- Cutting capacity/throat: 16¼"
- Max. cutting height: 12⅛"
- Blade size: 131½" L (⅛"–1" W)
- Blade speeds: 1700 & 3500 FPM
- Quick-release blade tension lever
- Approx. shipping weight: 346 lbs.

MADE IN AN ISO 9001 FACTORY!

**G0513P** ~~$895.00~~ SALE **$875.00**

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The underlying complexity of a simple cup of tea is reflected in this pared-down, hand-tool-built Spessart Oak sideboard.

BY GEREMY COY

**ONLINE ▸ Free Model**

Download a free SketchUp model of this elegant Asian-inspired sideboard.
popularwoodworking.com/jun15

### 32 Wired for Beauty

This clever technique requires only common tools and a few hours of effort to add striking metal accents to your work.

BY DON WILLIAMS

**ONLINE ▸ Keynote Speaker**

Discover Woodworking in America 2015, where Don Williams will be presenting the keynote address.
popularwoodworking.com/jun15

### 37 Compound Angles, No Math

Your eye, and a smart way of using perspective, lets you set rake and splay without a sine, cosine or tangent in sight.

BY CHRISTOPHER SCHWARZ

**ONLINE ▸ Headed Level**

Watch a video showing how to level the legs of a sawbench with simple tools.
popularwoodworking.com/jun15

### 42 Floating Table

Learn some tricks of compound band-saw cuts as you build this table that seems to change its shape as you change your view.

BY BRIAN A. HUBEL

**ONLINE ▸ Table Basics**

Read "How Tables Work," a free article to help you design the perfect table.
popularwoodworking.com/jun15

### 49 Gravity by Design

Discover how small details can make a design seem lighter or more substantial.

BY DARRELL PEART

**ONLINE ▸ Picture Perfect**

Get free plans for a Greene & Greene-style picture frame.
popularwoodworking.com/jun15


FLOATING TABLE PHOTO BY LAUREN ALLEN; WIRE INLAY PHOTO BY DON WILLIAMS;
LEG DETAIL PHOTO BY DARRELL PEART; SAWBENCH PHOTO BY CHRISTOPHER SCHWARZ

# 30 Days For Dad Sweepstakes

It's time to give every dad his due with a month full of top-flight woodworking prizes. From May 23 through June 21 (Father's Day), *Popular Woodworking Magazine* and its sponsors are giving away a prize a day to celebrate dads. To earn your chance, you must enter separately for each day's prize. All entrants will qualify for the Grand Prize, a Jet 10" ProShop Table Saw (Model 708494K) with 30" fence, cast iron wings and riving knife.

## May 23

NORTON SAINT-GOBAIN

Pro Tri-Stone Sharpening System – IM313 Series

*www.nortonstones.com*
*Card #5*

## May 24

RIKON

Air Filtration System #62-400

*www.rikontools.com*
*Card #42*

## May 25

BESSEY Simply better

K-Body Revo Kit, KRK2440

*www.besseytools.com*
*Card #101*

## May 26

EASY WOOD TOOLS

Pro Easy Rougher

*www.easywoodtools.com*
*Card #39*

## May 27

Blue Spruce Toolworks
Hand tools for your finest work

Sloyd Knife

*www.bluesprucetoolworks.com*
*Card #104*

## May 28

KNEW CONCEPTS

Woodworker Fret Saw

*www.knewconcepts.com*
*Card #60*

## May 29

ARBORTECH

Mini-TURBO Woodcarving Blade

*www.arbortechusa.com*
*Card #99*

## May 30

M POWER

MPOWER CRB7$^{MK3}$ BUNDLE, CRB7$^{MK3}$ + Edge Trim + Edge Guide

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*Card #116*

## May 31

Earlex

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*Card #9*

## June 1

TrueTrac The Better Track Saw System

TruTrack Saw Guide System

*www.insighttoolworks.com*
*Card #84*

## June 2

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Klingspor's Woodworking Shop $100 Gift Card

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*Card #89*

## June 3

Oneida Air Systems

Dust Deputy Deluxe

*www.oneida-air.com*
*Card #35*

## June 4

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WoodRiver #92 Medium Shoulder Plane

*www.woodcraft.com*
*Card #49*

## June 5

BESSEY Simply better

30 Clamp Kit BTB30

*www.besseytools.com*
*Card #101*

## June 6

Excalibur

EX-21K Scroll Saw with Stand & Foot Switch

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*Card #17*

## June 7

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POPULAR Woodworking MAGAZINE

## June 8

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## June 9

MIRKA

DEROS Dust Free Sanding System

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*Card #31*

## June 10

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Precision Router Lift V2 (PRLV2)

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*Card #52*

## June 11

WORK SHARP

Work Sharp 3000 Sharpener System

*www.worksharptools.com*
*Card #119*

## June 12

ARBORTECH

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*Card #99*

## June 13

BESSEY Simply better.

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*Card #101*

## June 14

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*Card #107*

## June 15

LEIGH

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## June 17

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## June 21

### GRAND PRIZE

JET ProShop Table Saw, 708494K

JET

*www.jettools.com*
*Card #72*

## Enter every day

at www.popularwoodworking.com/30days

*Popular Woodworking Magazine* and its sponsors will award one prize each day from May 23 through June 21. The prize pictured on each day in the calendar above is the prize offered for that day. To register for a chance to win each prize, you must enter on the day the prize is offered, you may enter as many of the daily contests as you like but you are limited to one entry per day. All entries from the first 29 days will be eligible for the **Grand Prize: a JET 10" ProShop Table Saw (Model 708494K).**

*Registration starts midnight, EDT on May 23 and ends 11:59 EDT, June 21.*

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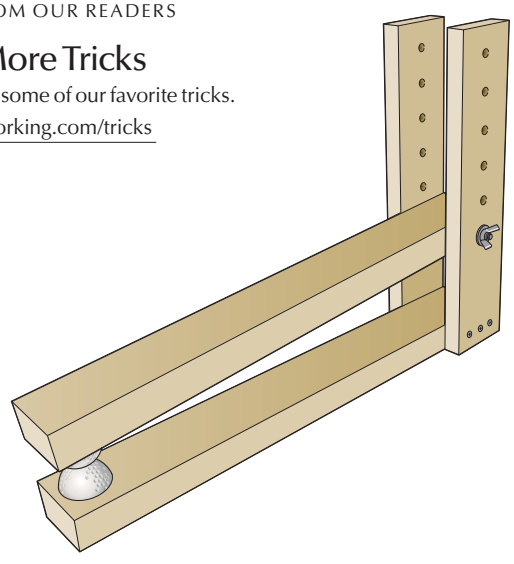
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POPULAR WOODWORKING MAGAZINE

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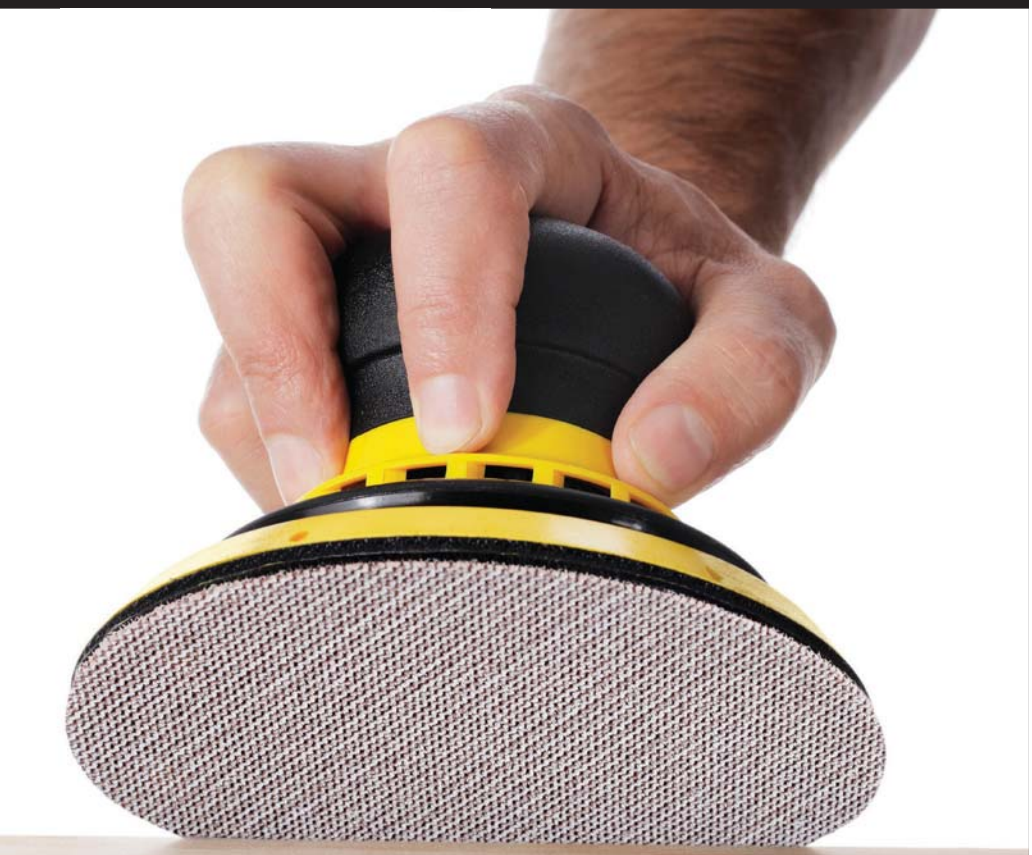
GRIZZLY PHOTO BY AL PARRISH; CHAIR PHOTO BY PETER FOLLANSBEE; TOOL CABINET PHOTO BY NARAYAN NAYAR; ILLUSTRATION BY MARY JANE FAVORITE

MIRKA

# Introducing Mirka® DEROS



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+

Abranet® Mesh Abrasives

+

Vacuum Hose

+

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# Make it a Shop Party

Woodworking can be a lonely pursuit. We pore over magazines, books, videos and the Internet in a never-ending quest to improve in the craft, then head to our shops to put that theoretical knowledge into practice and try out new things – usually by ourselves.

And while for many (myself included) the shop is a welcome place of escape from the everyday, working alone can at times be difficult (and sometimes rather frightening if you're new to a tool or technique). It's nice to have a woodworking friend or group of friends to bounce ideas off (and also from whom you can borrow clamps when necessary).

Classes and conferences are a great way to meet up face-to-face with other woodworkers and learn something new, but if your bank account and/or work schedule looks anything like mine, there are only so many of these you can attend.

But there's a fun and inexpensive solution: Gather a like-minded small group of friends and have a woodworking weekend party.

Several times in the last year, I've spent a couple days with good friends as we worked our way through some unfamiliar builds – three coffins and a Windsor-style sawbench.

The sawbench build was for Christopher Schwarz to work through a new class he was developing. Together, we helped him identify missing information, potential problems and more. By the end, we'd all learned something – and we each had a new sawbench.

Or do what Mike Siemsen and friends do. In his Minnesota shop every Tuesday night, anywhere from four to 10 people get together for "Tool Night," a weekly gathering that's been going on for six years. "It's a lot like poker night," says Mike, "but with tools instead of poker."

What's key is that the group is small enough so everyone has a voice – and a spot at the bench or work.

For the most part, Mike's group figures out how, then builds tools that are no longer available (many of them gleaned from André Roubo's "L'Art du Menuisier"). A lot of it is just for fun, says Mike, and "once you figure out how to make them, you can't stop." But sometimes, they put their heads together to come up with the perfect "X." (I've been trying to cajole him into writing about the Tool Night Saw Till, for example.)

With a mix of people, there's different knowledge, experience and opinion to draw from, all of which comes in handy when trying to figure stuff out. It's sometimes easier to not work in a vacuum.

So the next time you have a project or technique to work through, buy a bag of chips and phone some friends. **PWM**

P.S. In case you're wondering what the heck is going on the picture, Sean Thomas, John Hoffman, Andrew Lunn, Raney Nelson, Christopher Schwarz (who took the photo) and I were experimenting with three techniques for building coffins, from "Coffin-Making and Undertaking," a 1913 book on the craft edited by Paul Hasluck.

PHOTO BY CHRISTOPHER SCHWARZ

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# Playing the Angles on a Rohlfs Chair Leg

I am in the process of building the Charles Rohlfs 1898 desk chair featured in the February 2015 issue (#216).

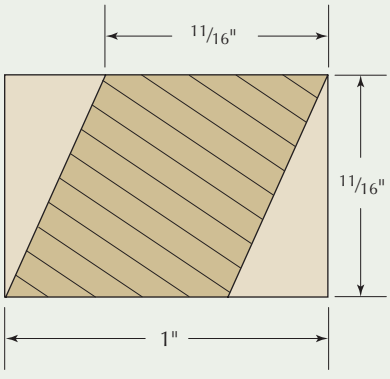
The drawing of the front leg profile on page 50 shows the leg as 11/16", not 1". The assembly instructions show 11/16" x 1" legs cut at 21°. The 11/16" faces are the front and back. Can you help clarify this?

Bill Majorossy,
Port Saint Lucie, Florida

*Bill,*
*It's great that you are building the Rohlfs chair.*

*The front legs of the desk chair are shaped like a parallelogram and are cut from a piece of wood 11/16" thick by 1" wide. The leg is 11/16" wide and the front and back faces are 11/16". To get this parallelogram shape, you need to cut it from a piece of wood that is 11/16" x 1". The illustration below shows the cross-section of the leg and how it is cut from the 11/16" x 1" piece.*

*Peter Marcucci, contributor*




## Laminated Products vs. SYP

I am pondering making a workbench from TimberStrand. Is this a viable alternative to Southern yellow pine (SYP)? SYP is very hard to come by in my area and laminated veneer lumber (LVL) is about twice as expensive. I will be doing mortise-and-tenon joinery.

Justin D. Kirk,
via e-mail

*Justin,*
*As you might know, I built a bench (with Christopher Schwarz) from LVL, for the November 2009 issue (#179); it's held up incredibly well (though were I to build another, I'd use solid wood for the base).*

*I've not used TimberStrand, but in reading about it online, it seems similar to LVL in that the wood fibers are oriented parallel, but TimberStrand is LSL (laminated strand lumber) rather than thin veneers glued together. I think it would work just fine structurally, but I don't know how it would look when resawn and glued into a benchtop.*

*I would recommend asking the lumberyard if they have a leftover length of LSL, then rip it and reglue it in the orientation you plan to use it to see how it looks before committing…if the look is important to you. (When we built the "Gluebo" we already knew what the top would look like – there was a restaurant nearby that featured tables from the material.)*

*But note that if you wish to use solid wood, SYP is our usual recommendation only for those who can get it; the real answer is that any wood can be used to make a bench. The material should be cheap, easy to get, heavy (if possible) and dry.*

*If you do use LSL for the top, any wood that meets the above specs would also work for the base (the LSL will impart plenty of weight).*

*Megan Fitzpatrick, editor*

## A Finish to Darken Maple

After watching the DVD "Build a Campaign Chair with Christopher Schwarz," I am building my first campaign chair with hard maple.

Can you recommend a finish to give a darker look to the maple?

Also, he recommended "black wax" in the video. Will that work on my maple? Where can you buy black wax?

Ken McCormack,
via e-mail

*Ken,*
*For what it's worth, I like the look of maple with a clear finish – why not let the beauty of the wood shine through (though it would give you a more modern look)?*

*But if you want to make it darker, the simplest way is to use an aniline dye (but test it first on offcuts, of course).Or, try out some gel stains (I've had good luck with the ones from General Finishes) on offcuts until you get the look you're going for – and gel stain has the benefit of reducing blotching.*

*The wax is Black Bison Wax by Liberon and you can get it at Woodcraft, Rockler, Van Dyke's, Amazon etc., but I'm afraid it doesn't work well on woods with closed grain such as maple (it works best on open-pored woods such as oak and mahogany).*

*Megan Fitzpatrick, editor*

## Use Stone Grader Properly

I agree with Megan Fitzpatrick in her review of the Tormek T4 in the February 2015 issue (#216).

After five years of use, my Tormek (a T7) has indeed proven to be a solid choice for my woodworking and general sharpening.

My T7 now shares space with a new T4. The T4 is starting out to be a worthy addition, having the same Tormek advantages at half the weight in a much smaller package. The T4 uses all the same jigs as the T7.

However, the paragraph about the gap in grits confuses me.

As a longtime active member of the Tormek Forum (tormek.com), I have observed that the most common dif-

CONTINUED ON PAGE 12



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CONTINUED FROM PAGE 10

ficulty is insufficient use of the stone grader. The stone grader converts the #220 natural grit of the sharpening wheel to #1,000 grit.

If used thoroughly, no larger scratches should remain from the initial grinding. If careful observation in good light reveals any larger scratches, one is not ready to move on to the leather honing wheel.

If a chisel is properly ground and honed, no other sharpening equipment should be necessary.

Ken Schroeder,
Columbus, Ohio

*Ken,*

*I'm talking about scratches from the #1,000 grit. Those are large, compared to scratches from my #4,000, then #8,000 stones.*

*To go from #1,000 grit to polishing skips through what I typically use, and unless I polish for a really long time, those #1,000-grit scratches remain evident.*

*As I wrote, the system is good, but I stand by my comments on the edge being less durable than what I can achieve with my waterstones, particularly in the same amount of sharpening time.*

*Megan Fitzpatrick, editor*

## Cutting Slots for a Saw Till

I am curious as to how you cut the slots for blades in the saw till on the lid on the "Dutch Tool Chest" (Issue #206).

Jim Pryor,
via e-mail

*Jim,*

*The way I do it is pretty simple. I lay out the slots that I want on the two boards that will become the saw till. Then, I saw stopped kerfs into the boards using a handsaw, band saw or table saw.*

*To finish up, I then plug the entry point of the kerf with a piece of scrap and glue. It works great.*

*Christopher Schwarz,*
*contributing editor*

## Have I Been Gluing Wrong?

I was watching PBS the other day, and Scott Phillips ("The American Woodshop") said you should always glue both edges any time you are connecting two pieces of wood.

The only time I have glued both edges is when I am using contact cement or certain types of spray adhesive.

Have I been wrong all these years?

Elvin Ogg
Gladwin, Michigan

*Elvin,*

*Well, the "recommended" way is to put glue on both surfaces, and I was taught to put glue on both surfaces for joinery (e.g. mortise and tenons, and both the pins and tails for dovetails).*

*On panel glue-ups, I apply on only one edge, them wiggle the pieces against one another to spread the glue equally before adding clamps.*

*The way PVA works is that it must wet both surfaces. If you get enough glue on one surface to wet its mating surface, then you need put glue on only one piece. But if you spread it thinly and there isn't enough glue to transfer to and wet the mating piece, you should spread it on both.*

*Over the years of working with various people in our shop and other places, I've seen probably an equal number spread glue on one and both surfaces for panels, but most of the people I've worked with do spread it on both sides of joinery glue-ups.*

*But at the end of the day … are your furniture pieces staying together? If so, your technique – and amount of glue – is working just fine.* **PWM**

*Megan Fitzpatrick, editor*

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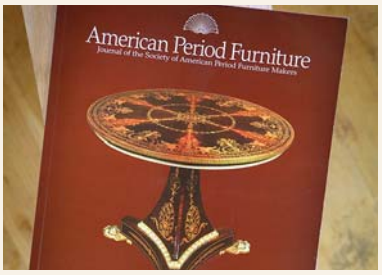


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# Long-reach Golf Ball Clamps

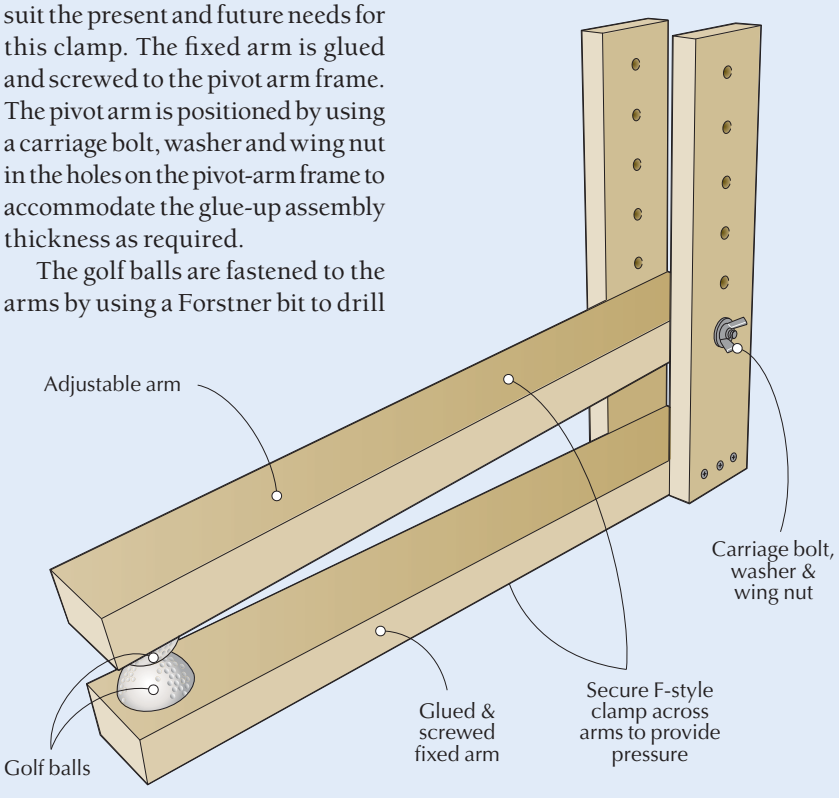
Sometimes you need to clamp parts that are out of reach of the throat depth of standard clamps. Here's a design for a long-reach clamp that can be made from 2x4 lumber, ¾" plywood or solid-wood scraps, some readily available hardware, an F-style clamp and golf balls!

The 2x4 lumber is used to make the fixed arm and the adjustable pivot arm. The length of these arms should suit the present and future needs for this clamp. The fixed arm is glued and screwed to the pivot arm frame. The pivot arm is positioned by using a carriage bolt, washer and wing nut in the holes on the pivot-arm frame to accommodate the glue-up assembly thickness as required.

The golf balls are fastened to the arms by using a Forstner bit to drill 1⅝"-diameter x ¾"-deep recessed holes in the arms. Press-fit the ball into the recess with a vise or clamp – no glue required.

The golf balls concentrate the clamping force, their spherical shape allows clamping on tapered surfaces if required and the resiliency of the golf ball surface acts as a clamp pad.

John Cusimano,
Lansdale, Pennsylvania




## Inexpensive & Easy-to-find Offcut Storage Solution

My lumber is kept in a rack on my shop wall, but I never had a decent way to store my rapidly growing pile of offcuts. I want to keep these short lengths of nice hardwood, but storing them on my lumber rack just made a mess.

Then I bought a 12"-diameter x 4'-long form tube that is used to create concrete columns. I cut the form in half, and set the tubes upright to hold the offcuts.

It makes for orderly storage, and everything is visible when I need a piece of hardwood of just the right length.

The tubes are available at all big box stores and lumberyards. They are made of heavy fiberboard and cut easily. I tack them to a wall or a bench leg so that they do not fall over. I even painted one to make it look a bit more classy.

Bill Wells,
Olympia, Washington

## Hole Saw Sander

I don't have an oscillating spindle sander, so to sand round profiles, I use my hole saw bits with some sticky-backed sandpaper around them.

It's a two-for-one tool for woodworkers on tight budgets.

Lenny Harrison,
Browns Mills, New Jersey

## Spiff Up Grungy Saw Nuts

I am building a panel saw and decided to use some old brass saw nuts for the handle. Of course they were tarnished and grungy. I chucked them up lightly in my cordless drill and held a woven abrasive pad to the face while triggering the drill.

I worked up through a couple of grits, and they now look great.

Jonathan Snyder,
Anchorage, Alaska



ILLUSTRATIONS BY MARY JANE FAVORITE

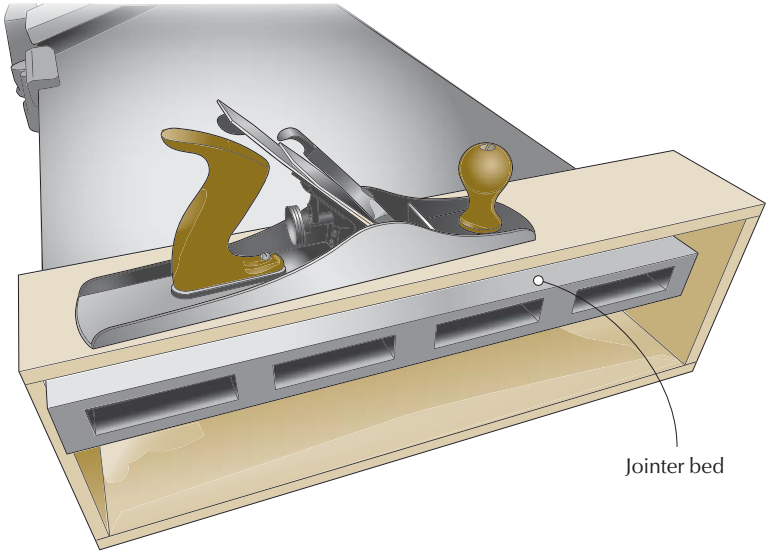
## Jointer as Planing Sleeve

I was planing some tills for kids' tool chests and I realized I'd forgotten to finish-plane the outside of the till boards. I looked over at the beds on my 16" jointer and thought, "hmm."

That ended up working perfectly to sleeve the assembled tills over for planing (and would also work for small drawers or cases). A more common 8" or 6" jointer would work for even smaller drawers (I realize not everyone has a 16" jointer).

I sleeve bigger stuff over the bench pretty frequently, but this is the first time I've done it for smaller stuff. It worked great.

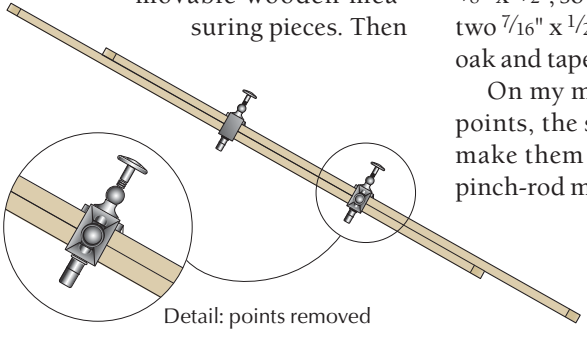
Jameel Abraham,
Cedar Rapids, Iowa




## Trammel Point Pinch Rods

I needed a set of pinch rods and found many straightforward ways for making them online. But I really wanted to make a nice-looking tool.

I noticed that all the instructions included two vise-like pieces and two movable wooden measuring pieces. Then I saw my trammel points and thought for the vise-like pieces, "I already have those parts!" All I had to do was make the sliding wooden measuring sticks and presto – a great second use for the trammel points.




The beam for my trammel points is $\frac{7}{8}$" x $\frac{1}{2}$", so for the pinch rods I made two $\frac{7}{16}$" x $\frac{1}{2}$" sticks out of some scrap oak and tapered the ends.

On my mid-1800s brass trammel points, the sharp points unscrew to make them safer to handle when in pinch-rod mode.

Aaron Henderson,
Varina, North Carolina

## Alcohol-aided Dovetails

It is fairly well-known that wetting the end grain of softwoods with alcohol reduces tear-out during planing, but I have never seen someone utilize this trick while chopping dovetails. I just did and it's fantastic.

Crumbling end grain reduces the strength of a dovetail joint. Plus, the crumbling can be so bad in softwoods that it shows in the finished joint as unsightly gaps on the finished face.

The trick for efficient application is to use a spray bottle filled with alcohol. After using a coping saw to cut close to the baseline, spray the end grain with alcohol, then drop a sharp chisel right into the line. **PWM**

Joe Powers,
Palo Alto, California

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# Grizzly Track Saw 'Master Pack'

## Performance isn't compromised in this inexpensive plunge-saw kit.

I've long been a fan of the track saw. For me, there's no faster, safer or more reliable way to break down sheet goods into sizes I can handle. While I can wrestle a 4' x 8' sheet of 3/4" plywood onto the cabinet saw if I must, it's not easy and there's every possibility I'll hurt myself – or worse, get a less-than-perfect cut.

With a track saw, you simply set up your work on sawhorses (or on the floor atop a sheet of rigid insulation), align the track to your cut line, set the saw for the angle and depth of cut, then make the cut. It really is that simple.

If you often work with sheet goods, this is a tool that belongs in your shop, and at just $245 for Grizzly's "Master Pack" (which includes the saw, a 55" guide rail and accessory pack), there's no reason to not have one.

After wrestling (sometimes unsuccessfully) with sheet goods on the table saw for a day or two last year, I switched to a Festool TS 55 track saw to cut numerous plywood sheets to size for the bulk of my kitchen cabinets. But I'm done with the 3/4" ply work, so to compare similar materials, I put the Grizzly system to use on 1 1/2"-thick butcher-block countertop material (I used the Festool when I installed my countertops – no way I could lift that heavy glueup onto the table saw without help).

While there are some things I like better about the Festool model, power and performance are not among them. The Grizzly's 160mm-diameter, 2.2mm-wide, 48-tooth blade had no trouble zipping through the thick material, and it left a clean edge. The tool has a variable depth of cut at 90° of up to 1 31/32" while riding on the track (just slightly more than the 1 15/16" of the Festool). At the maximum 45° tilt, the Grizzly cut depth is 1 7/16".

As with all track saws, the rail has non-slip backing; while the included clamps are recommended for holding the rail securely at the cut line, I made a few cuts without them and experienced no problems. The weight and cut ergonomics keep things on track.

This is unquestionably an excellent tool for the price, but there are two minor things that are better on the Festool: You need two hands to change the blade on the Grizzly (a one-handed operation with the Festool), and the 1 1/2" dust-collection port location makes it difficult to connect a hose with a rigid coupling and for the hose to clear the work.

***Great buy.*** *The inexpensive Grizzly track saw makes safe cuts from 90° to 45° with ease.*

But there's also one major problem: the plunge-release mechanism. I cannot reach it as directed with my hand around the grip – and neither can three of the four men in my office. It is literally a stretch for the guys, and I have to remove my hand from the grip entirely to disengage the lock. It's inconvenient, and makes for a less smooth and comfortable operation.

Still, for less than half the cost of the Festool model (and less than the Makita and DeWalt models we've tested), the Grizzly T25552 Master Pack is certainly worth considering – particularly for those with larger hands.

*— Megan Fitzpatrick*

CONTINUED ON PAGE 18

### Track Saw Master Pack

**Grizzly** ▪ grizzly.com or 800-523-4777

**Street price** ▪ from $245

▪ VIDEO *See the Grizzly track saw in action in a free video.*

*Price correct at time of publication.*

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CONTINUED FROM PAGE 16

# Earlex Steam Generator for Steam-bending

Steam-bending has always required a certain amount of jury-rigging to make the steam: adapting a propane burner, retrofitting a kettle or tweaking a wallpaper steamer. Now Earlex has made steam-bending a little easier by offering a steam generator that is simple to hook up to any steam box via a 1/2"-diameter hole.

In essence, the Earlex WS77 is a wallpaper steamer that is sold without a steam plate. Instead of a steam plate, you get a brass nipple that allows you to easily attach the steam generator to any steam box. First, drill a 1/2" hole in your steam box. The nipple threads into the hole and is secured by a brass backing nut. You are in business.

The WS77 holds about 1.3 gallons of water, which will give you two hours of continuous steam – more than enough for short runs of parts. Once you plug in the steam generator (there is no switch), you'll get steam flowing in about 30 minutes. I was completely happy with the amount of steam the Earlex pumped out. My steam box was at 212°F after only 10 minutes of steaming.

I decided to purchase the Earlex because it is safer than having a propane tank in your shop and the Earlex also has an auto-shutoff switch. When the tank runs dry, the unit shuts off.

The only thing I'm not happy with is the hose. At 12' in length, it is ridiculously long and there is no easy way to shorten it. The hose needs to be no more than 3' long for steam-bending. Anything more is a tripping hazard and a waste of heat.

On balance, the English-made Earlex is an excellent and safe way to get started in steam-bending. Now I just need to figure out how best to shorten the darn hose.

*— Christopher Schwarz*

### Earlex WS77

**Earlex** ▪ earlex.com or 888-783-2612

**Street price** ▪ from $67

▪ VIDEO *See the Earlex steam generator in action bending a chair's crest rail.*

*Price correct at time of publication.*

# Arbortech Contour Random Sander

I've been building a stacked-lamination piece with plenty of concave and convex curves that require a good deal of sanding. Arbortech's new Contour Random Sander has helped.

Out of the bag, the sander includes everything you need – a metal stem containing two independently rotating shafts that produce the "random" action, a flexible rubber backing pad and 35 adhesive-backed sanding discs ranging from #80 to #600 grit.

The tool fits any standard 4" or 4 1/2" angle grinder. Setup requires only a few minutes and the learning curve is pretty fast. And, unlike some other sanding attachments I've used, this one leaves no burn marks or edge gouges. The 50mm backing pad easily navigated around the tightest curves and the sanding discs held up for a considerable amount of time.

My heavy-duty angle grinder did result in a bit of fatigue after several hours of use, so if you own a lighter-weight grinder, I recommend it for this particular attachment. As with most sanding tools, you'll need to be diligent with dust collection, not only for health reasons but for keeping a clear view of your progress as you sand.

I was able to easily remove then re-apply used sanding discs to go back to previous grits. However, I also found that it's important to carefully remove any used sanding pads to avoid damaging the softer rubber backing pad.

I think this grinder attachment is best-suited for the serious hobbyist rather than for industrial or professional use. But for anyone looking to build the occasional woodworking project with a shaped or sculpted form, the Contour Random Sander is worth the money and fills a gap where tedious and time-consuming hand-sanding typically applies. PWM

*— Andy Brownell*

### Arbortech Contour Sander

**Arbortech** ▪ arbortechusa.com or 866-517-7869

**Street price** ▪ $89

▪ BLOG *Read more about this grinder attachment at brownellfurniture.com.*

*Price correct at time of publication.*

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# Secrets of the Cyma Curve

## Invisible lines and circles explain the beauty of a series of fair curves.

I can still remember Holloway's farmhouse. Even in summer when the fireplace was cold, the smell of wood smoke lingered in the air. That pungent aroma, combined with a skillet of fried chicken and fresh greens wafting in from the kitchen, pulled you into the heart of the house.

Wide plank floors squeaked as food made its way to a round oak table surrounded by old ladderback chairs. Not the most comfortable chairs, but if you pulled yourself around sideways and hooked an elbow around a back rung, you could settle in for the banter and laughter that always followed a meal.

In my memory, I can still run my hands over the curved contours and worn places on that old farm table and chairs. It's a powerful connection, and if there is anything magic about design, it's about making connections.

Often the most powerful connections are things hard to define. Compelling designs often convey vigor, strength, nature, youth, surprise or delight. A thoughtfully designed chair can recall feelings of warmth, safety, friends and health.

How does a design do even one of these things? There are a million answers to that question, but the short version is to engage multiple senses. A straight line may be the shortest distance between two points, but a curved line captures our eye, our touch and our imagination.

***The roundabout way.*** *Cyma curves abound in furniture designs both traditional and contemporary. Once you understand what lies beneath, it opens up the world of curves.*

### It's What You Don't See

Many woodworkers are leery of tackling curves and with good reason. It's not just the thought of leaving behind predictable straight lines and simple square joinery. It's the fear of trying to sort through something in our mind's eye that seems like a plate of spaghetti.

It's hard to imagine how that confusing jumble could become a graceful pleasing curve flowing naturally across a crest rail on a chair back. But there are some hidden keys that can go a long way toward helping you gain skill and confidence.

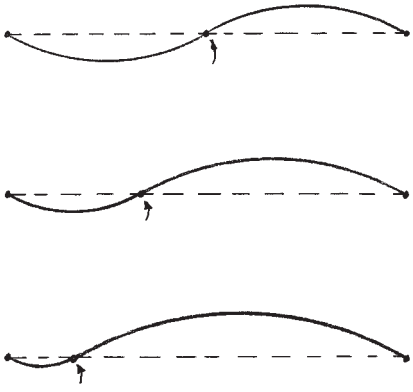
First, let's take a look at a simple "S" or cyma curve. This flowing line is ubiquitous in furniture design in both historical and contemporary work, and it has some invisible elements just beneath the surface.

Once you become aware of those hidden parts, it can help in deconstructing curves you see in the wild, as well as getting comfortable with applying curves to your own designs.

We don't really leave straight lines behind when we dive into the world of curves just like we don't leave the past behind – it's always a part of you.

Every cyma curve spans an invisible straight line. This straight line, or chord, defines the beginning, the ending, and the point where the arcs connect and transition from concave to convex.

This transition point is very important. You can alter a curve dramatically by shifting it.



***Get the point.*** *Cyma curves always flow above and below an imaginary straight line and are governed by the position of the middle transition point.*

CONTINUED ON PAGE 22



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CONTINUED FROM PAGE 20

Our imaginary straight line also supplies several other important keys. That flat line gives the eye a reference to judge the speed of the curved arcs.

Speed is a term to describe the character of a curve. A slow curve is gentle and gradual, while a fast curve is steep and plunges dramatically.

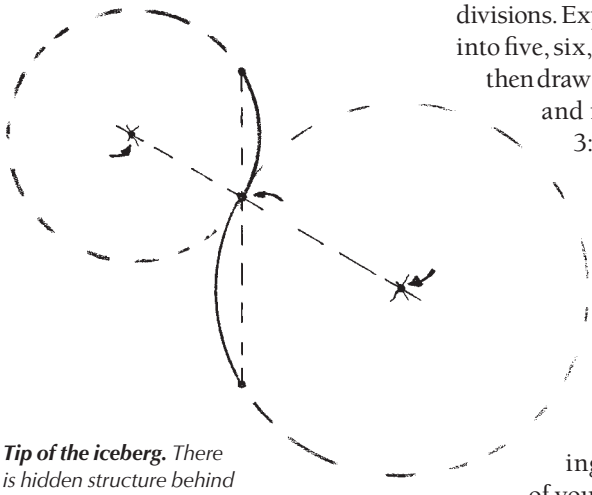
Our imaginary line orients the direction the cyma is flowing. Curves take a roundabout way to get from A to Z, and in doing so gently carry the eye along like a dry leaf before a breeze.

Once we see our imaginary chord, we can note with clarity whether our curve is flowing up or down, or a series of curves meandering along in a dance.

Secondly, each arc in our cyma curve has a fulcrum point. When you look at a cyma curve, try to imagine joining two sections of a circle together. In your mind, locate the pair of invisible fulcrum points and imaginary circles that lurk beneath the surface.

To the untrained eye, this might seem confusing at first, but as you gain understanding it will help you experiment with curves.

Note that when a cyma curve flows seamlessly or sweetly from concave to convex, a straight line that connects the two fulcrums will also pass directly through the transition point.



***Tip of the iceberg.*** *There is hidden structure behind every curve that can help you detect the true nature of what your eye actually sees.*

## Simple Makes Sublime

Our goal is to have curves become second nature so that graceful fair curves flow intuitively from our inner eye to a pencil, gouge or drawknife in our hand. One way to help this along is with some simple and playful exercises with a compass.

We begin by learning to draw a gentle arc that uses three steps and leaves the compass in one fixed setting for all three steps. For this simple curve, we draw a straight line or chord and mark both a beginning and ending point for our arc.

Position the compass point at one of our ending marks and adjust the pencil until it just reaches the opposite mark. We want to establish a fulcrum out in space, so we swing the pencil upward in an arc toward an imaginary north pole.

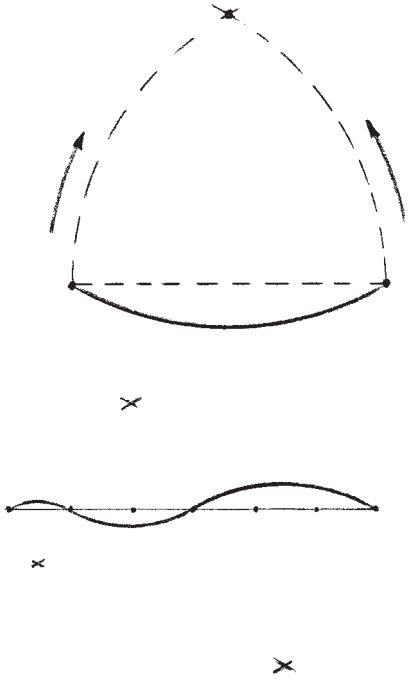
Leaving our compass at this setting, reposition the point across to the opposite ending mark and swing a second arc upward until it crosses the one we just drew. Where these arcs cross is our new fulcrum to draw a gentle curve spanning the beginning and ending of our chord.

Now that you know how to generate this simple arc, use this method to experiment with combining different curved combinations along a line.

Draw a series of chords, then use dividers to step each chord off in simple divisions. Experiment by dividing lines into five, six, eight or nine equal parts, then draw different pairings of major and minor arcs, i.e., 2:3, 1:2, 3:5. See how many simple curved combinations you can generate.

For added fun, go back and overlay simple curves over the top of the combinations you've already drawn. You might find yourself delighted to see the flowing lines dance off the end of your compass.

Obviously there are innumerable curved combinations beyond this one simple compass arc. The goal is always to train the eye so your intuition guides your hand and tools. This simple exercise is just the first step in helping you tap into the connection between your hand and eye. **PWM**



***Compass play.*** *Use the simple method above to create an arc spanning two points. Then create a series of curved combinations of your own. Just see what sublime lines jump from the end of your compass!*

*George is the author of two design DVDs (Lie-Nielsen Toolworks) and writer of the Design Matters blog.*

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Design Matters

Design Matters dives into the basics of proportions, forms, contrast and composition to give you the skill to tackle furniture design challenges with confidence.

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# Sideboard Fit for Tea

BY GEREMY COY

Design without compromise: An exercise in high-end handwork.

***Properly gauged.*** *A panel gauge keeps the cabinet's outer parts a consistent width, making it easier to align the grain at the corners.*

***Saw the dados.*** *Make the case's deep, narrow dados by sawing their full length and depth just inside the layout lines.*

***Entrenched.*** *Clear the waste with a chisel driven by a mallet.*

***Division by dados.*** *The vertical divider separating the left and right sides of the cabinet has 1/4" tenons that slip into dados in the cabinet top and bottom.*

Sometimes a cup of tea is more than a cup of tea. Its surface may be still, its color translucent and its container unadorned. But in a single sip of hot water, you can taste the time of year the leaves were harvested, the sun that touched them from above and the earth drawn into them from below.

This is not so different from woodworking. As woodworkers, we're concerned with transforming natural materials into creations of our own, hoping all the while that they retain some of the unimaginable complexity of their former lives. This project, a sideboard for preparing tea, is an opportunity to unite two arts, both of which celebrate simplicity and reflection and, in the modern spirit, are capable of presenting both calm, unassuming surfaces and the living forces roiling in their depths.

To achieve this in the form of a standing cabinet, my guiding principle has been to take away all that is extraneous and leave only what is necessary. The cabinet is made from pale, straight-grained Spessart oak – aesthetically calming and unobtrusive. Symbolically, too, it seems in keeping that a piece meant for quiet, contemplative moments be made from ancient, slow-growing timbers. In addition to the careful selection of lumber, the components are as thin as practicable; the outer box is 5/8" thick, while most of the interior dividers are a relatively wispy 3/8".

The soul of the piece is the left-most cubby, intended to hold a cherished teapot or bowl. In contrast to the austerity of the cubby, the right section of the cabinet is filled with dividers and drawers that intersect to form muted patterns. In other words, the fullness of the right section enhances the emptiness of the left.

In addition, the dividers and drawers are progressively set back from the cabinet's front edge. The varying shadows they cast hint at the richness and mystery of an organizing principle expressed through otherwise simple shapes. They point, too, at function: a stately teapot resides in the deepest space, cups on a slightly narrower shelf, and spoons and whisks in even smaller drawers.

Because the rectangular case is the focus of the piece, the legs are designed to visually intrude as little as possible, while at the same time providing a subtle feeling of lift and sturdiness. While there's nothing new under the sun, they're attached by means of a somewhat unusual joint that allows for a minimal base, and they're tapered, curved and rounded to soften their form.

In this article, I'll briefly touch on constructing the main case, provide a step-by-step explanation of cutting the leg joint, and walk you through making the back's mitered joints. I use hand tools exclusively to perform these tasks, a method that seems to suit the quiet, intentional spirit of tea.

## Make the Case

The four sides of the outer case are joined together with mitered, full-blind dovetails, which allow the grain of a single piece of oak to flow seamlessly around its corners with minimal distraction. The case is built with traditional joinery techniques, but two details are of note.

The second layer of drawers rides on a frame that includes dust panels

***Thin shavings.*** *Holding thin pieces such as the 1/8" dust panels can be challenging. I plane them using a stop in my bench.*

***Two-for-one joinery.*** *Both the dust panels and runners of the upper drawer frame slip into the same 1/8" grooves cut into the front and rear dividers.*

***Push to assemble.*** *The drawer frame and cup shelf slide in from the back. A dab of glue at the front of the dados will keep them in place.*

***Wood is flexible.*** *Gently bend the thin frame and shelf to install the vertical drawer dividers.*

between the runners. While this might seem extravagant, it simplifies construction in addition to adding a bit of flair. Grooves in the frame not only house the panels, but also make sufficient mortises for short, 1/8"-thick tenons cut into the ends of the runners. This means you can make two joints in one operation.

Installation of the vertical drawer dividers is also slightly unorthodox. First, slide the drawer frame and the cup shelf into place. Then carefully but confidently bend the drawer frame upward to accommodate the lower vertical divider's 3/32" tenons. Do the same for the next layer. This is as terrifying in practice as it is in print, but if you fight through the inevitable shortness of breath, the dividers will lock into place and create a very rigid framework.

## Unusual Legs

Rather than a complex network of legs, rails and stretchers, the sideboard stands on four independently joined legs. They're made sturdy by means of an unusual two-part joint that is surprisingly easy to cut.

Start by milling four pieces of riftsawn oak 1 1/8" thick x 2 1/4" wide x 34" long. At the top of each leg, measure 1 3/4" from the inside edge to locate the long tenon's shoulder and 1 7/16" to mark its depth. From the bottom of the leg, measure up 26 7/8". This line will be the joint's visible shoulder underneath the cabinet. Measure up 5/16" from the previous mark; this is the top of the dovetail.

Cut the resulting 1 7/16" x 7 1/8" notch with a saw, then pare the sawn faces back to the scribed lines, making sure they're square to your reference face.

Next, create an L-shaped tenon by removing wood from each wide face. Set a marking gauge to 1/4" and scribe around the inside edge of the notch. Remove waste along the base of the joint by placing a chisel just inside the scribed shoulder line, chopping then paring toward the line at an angle. Continue until you're just barely above the gauged line. Cut the vertical half of the joint by chopping along its length and paring from the side. Again, work to just above the gauge line, and finish off the tenon cheeks with a router plane.

Mark the dovetail in pencil by measuring in 1/8" at the shoulder line of the joint and connecting these points to the upper corners of the tenon. Alternately chop and pare with a chisel until you approach the pencil line and shoulders. Square the shoulders to the base of the dovetails. Using a paring block that has been planed to the angle of the dovetail and to the appropriate height above your bench, guide the chisel in making gentle paring slices until it bottoms out. Finally, saw 1/4" off both the face of the dovetail and the top of the tenon to create clean shoulders.

Cut the other half of the joint directly into the bottom and sides of the main case. Because the leg slides into the case horizontally, the dovetail must enter its socket before the tenon engages its mortise. For this reason, I mark and cut the dovetail half of the joint first, and then, with the leg seated against the case side, scribe the final position of the long mortise.

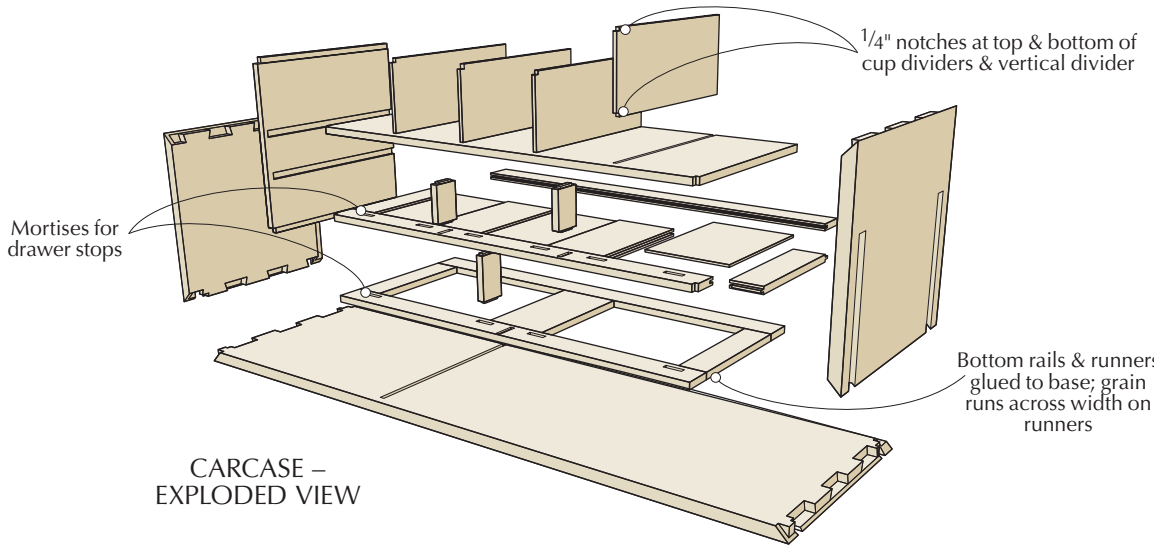
To begin, hold the leg in position 1/2" back from the front edge of the case with the face of the dovetail pressing

***Leg layout.*** *The aim is to create an L-shaped notch in which the cabinet will rest. A long tenon and sliding dovetail will keep it in place.*

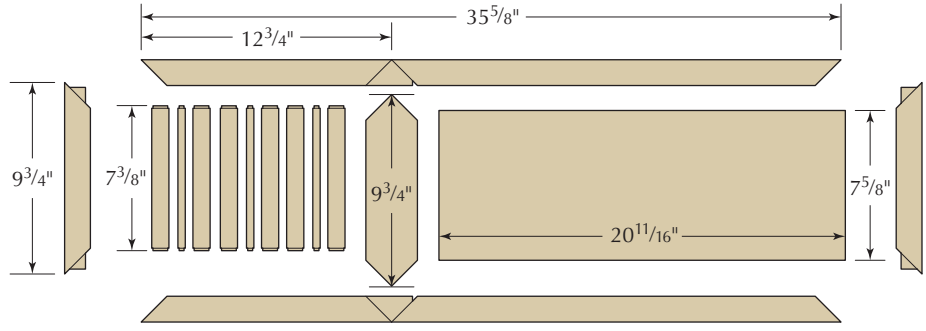
***One-walled mortise.*** *To form the long tenon in each leg, chop inside the shoulder line and pare from the side to remove the waste.*

***Pared with poplar.*** *Guide your chisel with a paring block to perfectly form each leg's dovetail.*

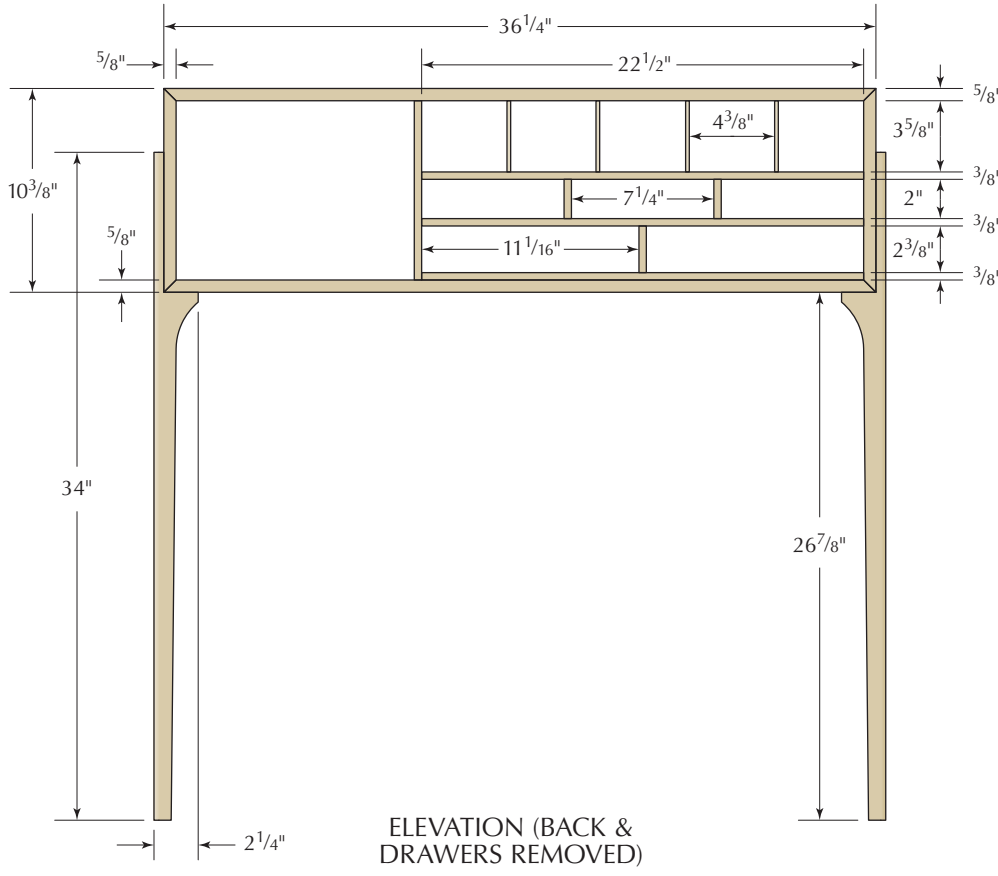
***Trace the tails.*** *Locate the position of the leg joinery by holding each one against the side of the cabinet and penciling in its silhouette.*




CARCASE – EXPLODED VIEW




BACK – EXPLODED VIEW




ELEVATION (BACK & DRAWERS REMOVED)

## Sideboard Fit for Tea

| NO. | ITEM | DIMENSIONS (INCHES) T | W | L | MATERIAL | COMMENTS |
|---|---|---|---|---|---|---|
| **CASE & LEGS** | | | | | | |
| ❑ 1 | Top | 5/8 | 10 7/8 | 36 1/4 | Oak | |
| ❑ 1 | Bottom | 5/8 | 10 7/8 | 36 1/4 | Oak | |
| ❑ 2 | Sides | 5/8 | 10 7/8 | 10 3/8 | Oak | |
| ❑ 1 | Vertical divider | 3/8 | 9 3/4 | 9 3/4 | Oak | 5/16" TBE* |
| ❑ 1 | Cup shelf | 3/8 | 9 1/2 | 22 7/8 | Oak | |
| ❑ 1 | Drawer frame, front | 3/8 | 1 1/2 | 22 7/8 | Oak | |
| ❑ 1 | Drawer frame, back | 3/8 | 1 1/2 | 22 7/8 | Poplar | |
| ❑ 2 | Frame runners, outside | 3/8 | 1 11/16 | 6 7/8 | Poplar | 1/4" TBE* |
| ❑ 2 | Frame runners, center | 3/8 | 3 3/8 | 6 7/8 | Poplar | 1/4" TBE* |
| ❑ 3 | Dust panels | 1/8 | 6 5/8 | 4 13/16 | Poplar | |
| ❑ 1 | Drawer rail, front | 3/8 | 1 1/2 | 22 1/2 | Oak | |
| ❑ 1 | Drawer rail, back | 3/8 | 1 1/2 | 22 1/2 | Poplar | |
| ❑ 2 | Drawer runners, outside | 3/8 | 6 3/8 | 1 1/2 | Poplar | ** |
| ❑ 1 | Drawer runner, center | 3/8 | 6 3/8 | 3 3/8 | Poplar | ** |
| ❑ 1 | Vertical drawer divider | 3/8 | 1 3/8 | 2 5/8 | Oak | 1/8" TBE* |
| ❑ 2 | Vertical drawer dividers | 3/8 | 1 3/8 | 2 1/4 | Oak | 1/8" TBE* |
| ❑ 4 | Cup dividers | 3/16 | 8 7/8 | 3 7/8 | Oak | |
| ❑ 10 | Drawer stops | 1/4 | 1 | 1/4 | Oak | |
| ❑ 4 | Legs | 1 1/8 | 2 1/4 | 34 | Oak | |
| **BACK** | | | | | | |
| ❑ 2 | Rails | 1/2 | 1 5/16 | 35 5/8 | Oak | |
| ❑ 2 | Stiles, outside | 1/2 | 1 5/16 | 9 3/4 | Oak | |
| ❑ 1 | Stiles, center | 1/2 | 2 5/8 | 9 3/4 | Oak | |
| ❑ 1 | Panel | 1/4 | 20 11/16 | 7 5/8 | Oak | |
| ❑ 6 | Wide slats | 5/16 | 7/8 | 7 3/8 | Oak | 1/8" TBE* |
| ❑ 3 | Narrow slats | 5/16 | 3/8 | 7 3/8 | Oak | 1/8" TBE* |
| **DRAWERS** | | | | | | |
| ❑ 2 | Fronts | 3/8 | 2 3/8 | 11 1/16 | Oak | |
| ❑ 2 | Backs | 3/8 | 2 3/8 | 11 1/16 | Poplar | |
| ❑ 4 | Sides | 5/16 | 2 3/8 | 9 | Poplar | |
| ❑ 2 | Slips | 5/8 | 1/2 | 10 7/16 | Oak | Miter, glue to fronts |
| ❑ 4 | Slips | 5/8 | 1/2 | 8 3/4 | Poplar | Miter, glue to sides |
| ❑ 2 | Bottoms | 1/4 | 8 3/4 | 9 15/16 | Poplar | |
| ❑ 3 | Fronts | 3/8 | 2 | 7 1/4 | Oak | |
| ❑ 3 | Backs | 3/8 | 2 | 7 1/4 | Poplar | |
| ❑ 6 | Sides | 5/16 | 2 | 9 | Poplar | |
| ❑ 3 | Slips | 5/8 | 3/8 | 6 5/8 | Oak | Miter, glue to fronts |
| ❑ 6 | Slips | 5/8 | 3/8 | 8 3/4 | Poplar | Miter, glue to sides |
| ❑ 3 | Bottoms | 1/4 | 8 13/16 | 6 1/4 | Poplar | |
| ❑ 2 | Pulls | 3/16 | 3/8 | 6 3/8 | Ebony | † |
| ❑ 3 | Pulls | 3/16 | 3/8 | 2 9/16 | Ebony | † |

*TBE = Tenon both ends; **Cut from wide stock – grain runs side to side in final orientation so there are no cross-grain gluing concerns when attaching runners to case bottom; †3/16" tenon into drawer fronts

***Chiseled sockets.*** *Dovetail sockets in the cabinet are cut with chops from above followed by paring from the ends.*

***A receptive cabinet.*** *Long mortises in the cabinet side receive the legs' tenons, while sockets admit the dovetails.*

against the side of the cabinet. Trace around the dovetail, then transfer the location of its base to the bottom of the cabinet using a knife and square. Extend the marks 1 1/2" before squaring between them.

If you cut the dovetail socket before the long mortise, you risk breaking off its cantilevered edges when enlarging the opening at the corner of the joint. Instead, first cut a 5/16" x 5/16" notch at the corner of the cabinet. Pencil in dovetail lines from the bottom corners of the notch to the knife lines on the bottom of the cabinet. Saw close to the pencil lines, then chop out most of the waste with a narrow chisel. To finish the sidewalls of the socket, carefully line up the same paring block used earlier with the scribed lines in the cabinet and clamp it in place. With a slicing motion, make successive passes until the wall is

***Trust your eye.*** *Use a long straightedge and a French curve to draw a pleasing outline on each leg.*

***Downhill slide.*** *After most of the waste is sawn away, smooth the inside face of each leg with a small, curved-bottom spokeshave.*

***Outer bulge.*** *Sketch a soft curve on the end of each leg, then work down to the lines with a jack plane.*

***Rasp to round.*** *Starting at the top of the curve, round over the inner, curved edges of each leg with a fine rasp.*

flat and straight. Clean up the bottom of the socket with a paring chisel.

Dry-fit the dovetail and scribe around the tenon to determine the exact position of the mortise. Chop from one end to the other and clear out the waste. Having one end of the joint open makes this much easier; you can both lever out chips and pare from the open end.

Make one final pass with a router plane to provide an even gluing surface for the tenon.

> "Form and function – what I weigh, is simply the net result. Beauty is a function. Some things we make are simply intended (hopefully) to be beautiful. That is legitimate. And often, it becomes a simple and honest goal."
>
> —*James Krenov (1920-2009), woodworker*

With the joints cut and fit, shape the legs. As seen from the front and measured from the outside edge, each leg tapers from $1\frac{1}{8}$" at a height of 24" to $\frac{7}{8}$" at the floor. Mark this taper in pencil, then use a French curve to connect the top of the tapered portion with a point on the inside edge $\frac{1}{2}$" down from the dovetail's shoulder.

Saw out the waste and smooth the resulting inside face with a spokeshave and block plane. The front and back of each leg are also tapered from $1\frac{1}{8}$" thick at their tops to $\frac{7}{8}$" at the floor. Mark these tapers in pencil and work carefully down to the lines with a long plane.

Finally, use a plane to round over the outside corners, leaving a bulge in the center of the leg's length. Soften the edges of the inside corners as well, but leave the inside face flat.

To simplify assembly, glue and clamp one leg at a time. When the glue in the leg joints has cured, flip the whole thing over and test for level on a flat surface. Make any necessary adjustments, then chamfer the bottom edges.

## Many-mitered Back

The back mirrors the interior of the cabinet; an outer frame is divided into two sections by a central stile, with slats behind the teapot cubby and a solid panel behind the drawers. The rails and stiles are mitered both inside and out, continuing the theme of clean, hidden joinery and making the back the most complex part of the project.

Make the outer frame from $\frac{1}{2}$" stock ripped to $1\frac{5}{16}$" wide. Mark the length of one rail and one stile directly from the rabbet in the back of the cabinet,

***Tenon & tail.*** *Each finished leg joint is composed of a long vertical tenon and a short sliding dovetail.*

***Enter leg.*** *Each leg slides laterally into the main case, dovetail first.*

***More than meets the eye.*** *Within the back's mitered stiles and rails lie hidden tenons and mortises.*

***Fence, improvised.*** *The head of an adjustable square makes a suitable temporary fence for shooting miters.*

***A pointed endeavor.*** *Begin the back's trickiest joint by sawing out the middle 3/16" of the central stile's pointy ends.*

adding just a whisper to each. Transfer those lengths to the other two pieces. Using a knife and an adjustable square, scribe the miter angle onto both faces of the pieces and square across the edges. Ensure that the bevel of your knife falls on the waste side to prevent damaging the edge of the miter.

Stub tenons project from the mitered ends of the stiles but stop short of passing through the rails. To achieve this, cut the stiles to their exact finished length, then use a mortise gauge to scribe the thickness of the tenons. The settings on the gauge should match both the 3/16" width of your plow plane blade and its distance from the fence when centered on the stile. Use another marking gauge set to 1/4" to scribe the length of the tenon (using the end of the stile as a reference) and then to mark its width (using the inside and outside edges). Saw the waste, being careful not to spoil the cleanly marked baseline. Finish by paring the shoulders square.

The tenons slip into mortises cut into the mitered ends of the rails. Shoot the rails to their finished length using an angled fence or adjustable square. Use the same mortise gauge to mark the mortise widths on the mitered ends. Mark the mortise lengths by squaring across the mitered ends from measurements made on the reference faces. Then simply stand the rails on edge and make alternate chops of the chisel with paring strokes to remove the waste.

The wide central stile is joined to the frame by means of a double-mitered bridle joint. For the miters to be even, the stile must be 2 5/8" wide – exactly twice the width of the rails – and the same length as the other two stiles. Find the center at each end and scribe the miters from those points. Saw the waste then finish the miters on a shooting board. Now use the mortise gauge to scribe the pointed ends then make vertical saw cuts down to the baselines. Remove the waste in the middle with a coping saw and paring chisel.

Plow 1/4" deep grooves in the central and right-hand stiles. The grooves in the long rails stop at the central stile, so cutting them involves an extra step. First, use a plow plane to cut as deep as possible without overcutting the stopped end. Then, with a narrow chisel, mortise out enough material at the end of the groove to allow the front or back half of the plow plane to sink fully into the groove. Continue plowing until you reach full depth.

Next, cut the second half of the double-mitered bridle joint. Mark the apex of the miters 12 3/4" from the left end of the rails. Scribe the miters from those points and use the mortise gauge to

***Clear the decks.*** *After marking the long rails with converging miters, chop and pare a notch close to your layout lines.*

***Scraping bottom.*** *A router plane leaves a smooth, consistent surface for the mouth of the bridle joint to close on.*

***Miter sandwich.*** *The central stile's two outer points slip over the interior portion of an outer rail.*

## DRAWER CONSTRUCTION

The five drawers are constructed with half-blind dovetails at the front and through dovetails at the back. But instead of a groove in the drawer sides and front to capture the bottoms, I used mitered "slips." The drawer sides are a slender 5/16"; were I to plow grooves sufficient to support the bottoms in such thin stock, the sides would be significantly weakened. Slips, on the other hand, allow for both attractively thin sides and properly supported bottoms.

To make the slips, plane a small board to the appropriate thickness and square one edge. Plow a 1/4" groove 3/16" from the reference edge, then use a marking gauge to scribe the slip's 5/8" height. Saw close to the scribed line and finish the edge with a block plane.

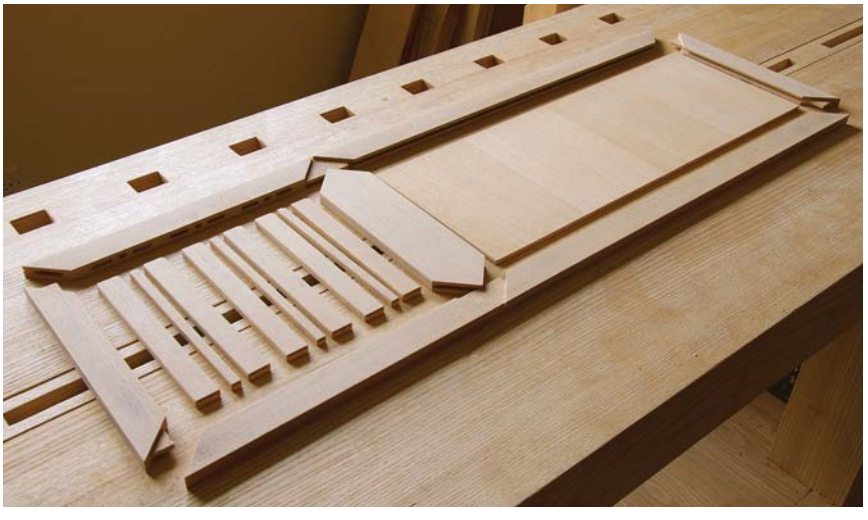
Miter both ends of the front slip and glue it to the drawer front. Miter the front end of each side slip and cut the back ends flush with the rear of the drawer. Turn the drawer upside down and mark where the side slips meet the inside face of the drawer's back. Saw a 3/16"-deep notch in the top of each slip, stopping at the mark. This notch allows the slip to fit between the drawer's front and back and aligns the top of the groove with the bottom of the drawer's back.

Profile the top of the slips to your taste; I opted for a simple bevel made with a block plane. Glue the side slips in place, and fit the drawer bottoms as usual. — GC

***Slips.*** *Instead of a groove plowed in the thin sides and the front of these delicate drawers, mitered slips are used to support the bottoms.*

mark along the inside edge of each rail. Chop and pare the waste until you're just above the scribe lines. A final pass with a router plane yields a smooth, consistent surface. Test the joint to make sure all eight miters close tightly.

Apply shellac to the panel, slats and inside edges of the rails and stiles in preparation for gluing. Once the glue has cured and the clamps are off, smooth the faces of the assembled back. It will likely be too large to slip into its recess. Take a few light shavings off each edge, test the fit and continue until it eases in. Work each side evenly so the miters remain aligned. When the back fits, put a thin bead of glue along the top and bottom and press it into place.



***Fifteen pieces.*** *The back has many parts and many angles. For sanity during clamping, use liquid hide glue or another slow-setting adhesive.*

### Savoring the Finish

Apply finish to the cabinet's components as they are assembled, ending with the exterior top and sides. For all surfaces, I opted for a few thin coats of shellac applied with a pad, followed by a round of buffing with wax and fine steel wool.

When you're done polishing, grab a mug and reflect on how a cup of tea may speak of more than sun and earth. Was it prepared thoughtfully or carelessly? Is it savored for its subtleties or unthinkingly consumed at once? Like a finished cabinet and the effort we put into making it, tea is evidence that how we go about our work has as much to do with the character of our creations as the stuff they are made of. If we approach our materials with awe and apply ourselves to laboring with finesse, our lives, like our cabinets, will be richer for it. PWM

*Geremy designs and makes furniture by hand in Alexandria, Va. His web site is geremycoy.com.*

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# Wired for Beauty

BY DON WILLIAMS

A rotary tool, hammer and a few shop-made tools are all it takes.

***Ideas everywhere.*** *Inspiration comes sometimes from humble and mundane sources. This $2 teak and brass box from a thrift store was a seed for this technique.*

I recently had the opportunity to explore a concept that has been rattling around the dark recesses of my cranium for almost three decades. It was inspired first by a spectacular pair of curly juniper boards (also known as aromatic red cedar) I bought way back when "just because" that were still awaiting their final purpose, and a cheesy Anglo-Indian carved teak box I use to hold my favorite "fussy" tools used for inlaying, engraving and marquetry.

The idea? Inlay wire into the presentation surface to enhance the already eye-catching beauty of the swirling grain pattern. The beauty of the technique is that it can be used for just about any kind of metal wire that



PHOTOS BY THE AUTHOR

fits the project – copper, brass, silver, pewter, aluminum, steel and even gold – and employed for any type of artistic expression, whether linear accents, scrollwork or free-form.

The use of inlaid wire has long historical precedence, perhaps nowhere more noteworthy than in the filigree inlays of exquisite antique firearms such as elegant dueling pistols and hunting long guns from centuries past. While the delicate accents of these artifacts were achieved through a skill developed during a long period of trial and error, by following the steps here, you can be up and running quickly because the scale and materials are more suited to both the modern shop and the task of furniture making.

## The Substrate

While I chose to emphasize burls and "curly" wood for my own pursuits, any wood ground, solid stock or veneer can suffice for the endeavor. Whether you are using solid lumber or veneer, the first step is to get the surface well-prepared for the processes to follow, by whatever process you feel most comfortable with (planing, scraping, burnishing, sanding etc.).

Once the surface is smooth and flat, apply a penetrating finish to harden the wood to a depth of about 3/32".

When using veneer, this can be accomplished fairly easily by hammer veneering with hot hide glue. When done correctly, it not only sets down the veneer but fully saturates it with glue that hardens in place. For solid lumber, I tend to select a reactive oil coating, such as a polymerized tung oil or something similar, first thinned 1:1 with mineral spirits.

Alternate materials include an alkyd resin/linseed oil varnish (Pratt and Lambert 38), gunstock varnish (Birchwood Casey Tru Oil) or a phenolic resin/tung oil varnish (Waterlox Original) or any other comparable analog, all thinned 1:1 with mineral spirits.

Slather on the impregnating concoction, and using a coarse-weave lint-free cloth, vigorously wipe off any excess when the liquid starts to get tacky.

Allow this application to harden,

***Deep finish.*** *The background material must be impregnated so that it will cut cleanly with the rotating tool cutter. Make sure to apply enough penetrating oil finish that it soaks in deep. The more exuberant the grain, the more finish will soak in.*

***Enhanced wood.*** *This walnut panel has been thoroughly saturated, enhancing its lively grain pattern both visually and structurally.*

which could take from a few hours to a few days. If it goes too slowly for you, try using naphtha as the thinner or adding a bit of Japan drier to jumpstart the drying reaction. Repeat the application and drying process until the surface is fully impregnated, but not to the point of building a glossy film above the surface.

## Cutting Channels for Inlay

Once the working surface is fully impregnated and hardened, it's time to begin cutting the channels into which you will inlay the wire. My preferred tool for this is a hand-held power rotary tool with a ball or straight burr

***Below the surface.*** *This selection of suitable penetrating coatings for consolidating the surface is just what I had on hand. It is by no means an exhaustive representation of appropriate products.*

## VARNISH RAG SAFETY

While it might be common knowledge, the below is always worth restating.

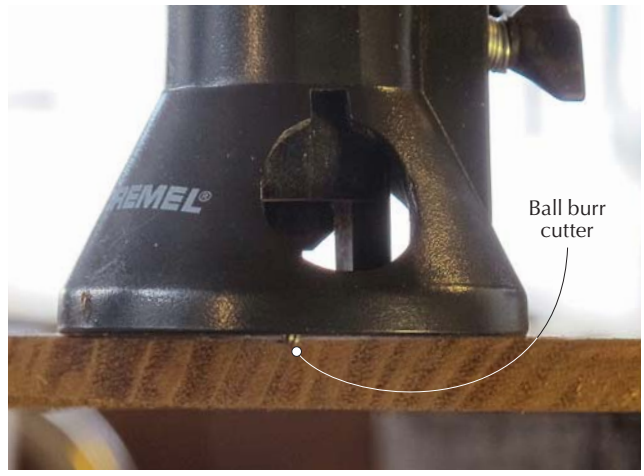
Make sure to follow sensible safety precautions when disposing of oily varnish rags, by either spreading them out to dissipate the heat generated by their exothermic (heat-producing) oxygen-driven polymerization reaction, or placing them in sealed glass jars to prevent the reaction and heat build-up.

—DW

bit roughly the same size (or slightly smaller) as the wire you will be inletting into the channel. I have mounted on mine a router-type collar I bought for about $10 at a home improvement store.

This allows me to think about one less thing when I am creating the channels, because it holds everything in a fixed attitude relative to the presentation surface. I set up the cutting tool so that the ball burr is about 75 percent

***The right tool.*** *It's important to make sure your rotary tool can accommodate 1) the right size cutter for your project, and 2) a stabilizing collar that can turn the tool into a mini-router, and enable its use as essentially a drawing tool.*




***Test first.*** *Setting up the rotary cutter's burr is probably the fussiest part of the technique. First test it on a scrap to make sure you are using the right cutter and the right depth setting.*

submerged into the surface, creating a rounded tunnel-like cavity for the wire, or, if using a straight burr, that it is cutting a channel slightly narrower and deeper than the wire diameter.

For this project with such a bold grain pattern, I selected a fairly large cutter and wire.

As to the pattern for the inlay, you can make it whatever you want. For linear inlays, simply allow the cutting tool to follow a straightedge while it is excavating the channel.

For more free-form designs, such as the one completed for this project, I first mark the impregnated surface with a pencil indicating the design I am trying to accomplish, then set up the tool, lighting and my eye so that I can carefully follow the pattern I have laid out on the surface.

Truth be told, this is the most stressful moment of the whole project, because if I lose track of the line or allow the high-speed rotating cutting tool to get away from me, I have wasted all the work to this point and either have to start over again or change the design. Or, you can just take the attitude of architects and software designers and call it a "feature" rather than a mistake.

***Groove on.*** *As long as you keep the rotary tool's collar firm against a straightedge, it will cut a straight groove. You can also create a stencil to create patterns for the inlay.*

***No limits.*** *The true beauty of artistry is that you can take it in any direction you want to go. Here I selected a pattern sympathetic to the grain; I could have just as easily made a design in counterpoint to that same grain pattern.*

***Follow along.*** *If you arrange the window in the collar attachment with the light and your line of sight, following your design isn't all that difficult if you concentrate.*

***Clear channel.*** *If the surface is well prepared and you use a steady, gentle touch with the rotary cutter and a burr that is set up correctly, you can achieve and nice clean channel for the inlay.*

## Choosing, Preparing & Shaping the Wire

Some of the wire you might select for inlay, most notably pewter (also known as lead-free solder), is ready to start working straight off the shelf.

Others, such as brass and silver, need to be first annealed, or relaxed, to reduce their stiffness and make them easier to pound and bend as needed. I anneal metals by either placing them directly on an electric hot plate on "High" and letting them cook until they have changed color thoroughly (which indicates they are done), or by reaching the same color by hitting them with the flame from a propane torch while the spool of wire is sitting on a bed of firebricks.

The wire then needs to be both flattened slightly with a hammer and anvil (in order to fit edge-wise through the narrowed opening of the ditch-like cavity into which it will be inset) and, if the design is circuitous, bent to mimic precisely the channels that have been excavated for them.

For flattening the wire slightly, I simply pound it lightly against an anvil using a hammer with a polished flat face. You will know almost immediately at this point if the wire has been

> "The things I make may be for others, but how I make them is for me."
>
> *—Tony Konovaloff, Cabinetmaker & author of "Chisel, Mallet, Plane and Saw"*

***Ready to use.*** *Most "plumber's" solder is soft enough to use right off of the spool.*

made soft enough for working. When you are sure that it is, polish the wire to remove any accretions or fire scale left by the annealing. I use an abrasive pad followed by a pumice cloth, then wipe it down with acetone to remove any surface contaminants.

Once the wire has been flattened, it must be bent to the shape of the channel, for which I use jeweler's filigree pliers.

You can just as easily use an extra pair of needle-nosed pliers, making sure to first remove any texture from the face of the jaws, then rounding the inside shoulders of the jaws with a diamond stone. (A boxwood tool, with a slot the exact dimension of the wire being bent, suffices equally well here.) With the pliers, gently bend the wire to fit exactly the opening into which it will eventually reside.

## Inletting & Finishing Inlay

Once the wire has been conformed to its channel, gently press it down into place. For this step I use a type of a punch often called a "chasing tool" that I make myself out of case-hardened concrete nails (see page 36).

With a small hammer and a light touch, I gently drive the wire down until it is fully set against the bottom of the channel, then continue working with my hammer and chasing tool to mushroom the slightly flattened wire to fill completely the channel.

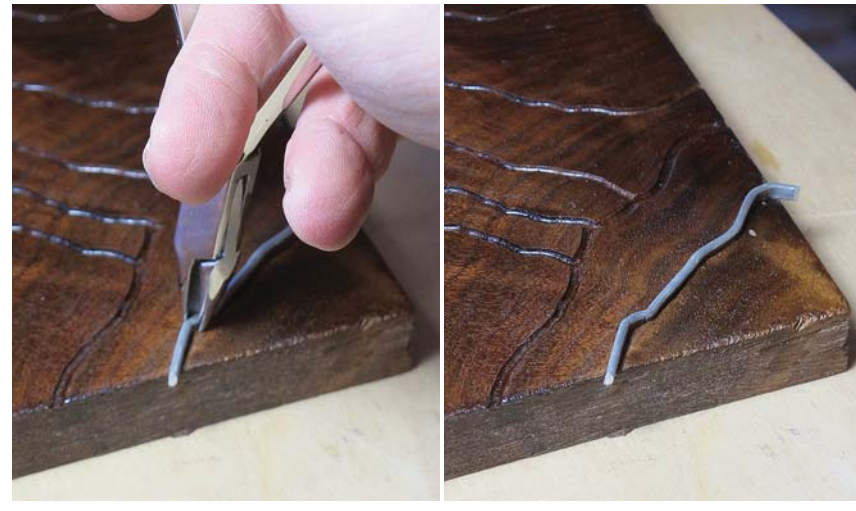
Once the wire is fully housed in the channel, I then decide whether it needs any adhesive to secure it in place. Usually any looseness will be overcome by subsequent applications of finish, but in

***Aim for dull.*** *These before-and-after photos provide the visual clues to annealing brass wire. When it is new and fairly hardened from rolling or drawing during manufacture, brass has a bright gold appearance. After annealing on a hot plate, it adopts a muted bluish/brown tone.*

***Base rotation.*** *I use a rotating brazing stand with firebricks when doing torch work, so I mostly rotate the workpiece, not move the torch.*

***Strike zone.*** *This is soft wire, so a strike or two will flatten the area of the hammer face.*

***Go digital.*** *While jeweler's filigree pliers are valued for bending brass or silver wire, for smaller-gauge soft pewter solder, fingers will suffice.*



***No regrets.*** *Take the time to get the fit perfect. Otherwise you will regret the unsatisfying result.*

## MAKE A CHASING TOOL

Very often in my work as a decorative arts conservator or creative artisan who works in a variety of materials – wood, steel, aluminum, brass, pewter, silver, ivory, mother-of-pearl, paper, leather, glass, plastic and composites, to name a few – I have needed one special tool to complete the task. Whether that tool was a special-shaped or precisely sized punch, a chasing tool ("chasing" is the process whereby you hammer the surface of a metal object using a punch-like tool and a hammer to create a desired surface texture), metal carving/engraving chisels, or a burnisher, many years ago I discovered a near-perfect source of the high-quality raw material from which I could make fine tools – concrete nails. I especially like them because they are easily available and ultra-cheap, yet perform and work nearly as well as expensive tool-steel stock.

I start with a nail of the preferred size and gently work the tip on a coarse water wheel to shape it. Generally, I use a Makita flat-wheel sharpener with an #80-grit wheel. The water wheel keeps the workpiece cool and allows the temper to remain intact for these exceedingly hard but sometimes brittle fasteners. (On rare occasion I will de-temper a nail before working it, such as when I need to bend the tool shank, then re-harden it when all finished.)

Once the rough shape is accomplished on the water wheel, I move to a diamond stone to finish off the shape, then buff the tip to a mirror surface on a buffing wheel. For chasing tools with a specific shape, I will impart that with a set of diamond files or slipstones before buffing. For metal-carving chisels I sharpen them like any other carving tool.

Both tapered case-hardened and round fluted concrete nails work fine, and each has their advantages. Both come in a variety of sizes. Flat-cut nails have one small end and one large end, and sometimes one or the other is preferable. Fluted nails come essentially round in cross-section, so when I need to make a precise pin punch, that is where I start.

The best part for me is that because the concrete nails are so common and inexpensive, I don't feel the need to treat them as precious objects. Yes they are high-performance tools, but they are cheap high-performance tools and I can make another one any time I need to. — DW

***Go lightly.*** *If you first bend the wire carefully, chasing it down into the channel is an easy task. Simply work your way down the length of the wire and tap it into place. Caution: Don't beat on the wire too hard; that will distort it upward and cause it to not fit cleanly.*

***Not a tough scrape.*** *Scraping the wire inlay flat is simple because the wire is much softer than a card scraper. Just make sure to work along the length of the inlay so you don't snag and risk dislodging it.*

***Popped.*** *Leaving the inlay proud of the surface is an eye-popping detail.*

cases where I am less confident, I will prepare some epoxy and either place a bead at the bottom of the channel, or thin it with a little acetone, then wick it in around the inlay, making sure to wipe up the excess immediately. Leave the wire alone until any adhesive has set up completely.

With the wire fixed in place, you can proceed with whatever finishing scheme you want to employ. This can be as simple as scraping the surface totally flat with a card scraper.

Another option is to leave the wire proud of the surface and burnish it with another homemade "nail tool," then move on to whatever applications of finish you want so that it is a glistening design element much like that used by Greene & Greene in some of their work. **PWM**

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*Don recently retired as senior furniture conservator after almost three decades with the Smithsonian Institution. He is the project leader for the ongoing production of André Roubo in English; his work can be followed at donsbarn.com.*

## ONLINE EXTRAS

*For links to all online extras, go to:*

- **popularwoodworking.com/jun15**

**WEB SITE:** *Visit the author's web site.*

**TO BUY:** *The author's latest book: "Virtuoso: The Toolbox of Henry O. Studley" (Lost Art Press).*

**WEB SITE:** *Discover Woodworking in America 2015, where Don Williams will be presenting the keynote address.*

**IN OUR STORE:** *"Creating Veneer, Marquetry & Inlay," a collection of technique videos .*

*Our products are available online at:*

- **ShopWoodworking.com**

# Compound Angles; No Math

BY CHRISTOPHER SCHWARZ

Once you understand 'resultant' angles, sawbenches (and chairs) are easy.

Most first-time chairmakers are intimidated by the compound joinery used to fasten all the legs, stretchers, spindles and arms. The truth is, it can be quite complicated if you try to figure out everything using trigonometry. But if you take some lessons from other chairmakers (like I did more than 10 years ago), there are easy ways to design and build chairs without math.

So put away the scientific calculator and fetch some scrap pine, 12-gauge steel wire from the home center and needlenose pliers. We're going to design and build a simple sawbench with five pieces of wood and compound angles.

## What is Rake, Splay & 'Resultant Angle?'

When chairmakers talk about the angles of chair parts, they use the terms "rake" and "splay" to describe them. Rake is the angle of the legs when you look at the chair from the side. The front legs rake forward; the rear legs rake back. Splay is the angle of the legs when you look at the chair from the front. Chair legs splay out.

I don't mess around with describing or measuring rake and splay much, except to explain it to other builders.

***One angle.*** *The bevel gauge is set to 15° and has been placed on the sightline on the underside of this sawbench. This "resultant" angle allows you to drill the holes for your legs with one line and one setting of your bevel gauge.*

Instead, I use what is called the "resultant angle" – one angle that describes both the rake and splay. You can calculate this angle with trigonometry, but there is a simpler way to think about compound leg angles for those who consider mathematics a cruel master.

The resultant angle is not measured from the front or side of a chair. Instead of looking at a chair from the front or side, you look at the chair from a position in space where the leg doesn't appear angled at all.

If I've lost you, try this: Sit on the floor with a chair in front of you. Rotate the chair until the leg closest to you looks to be perfectly 90°. Imagine that one of your eyes has a laser in it and can shoot a line through the leg and onto the seat. That laser line is what chairmakers call a "sightline" – an imaginary line through the leg and onto the seat. Put a single bevel gauge on that imaginary line and you can position a leg in space with a single setting on a bevel gauge that is placed on your sightline.

Most plans for Windsor chairs include instructions for laying out the sightlines and the resultant angles for setting your bevel gauge. But what if you want to design your own chair? Or you want to build a table, desk or footstool using the same joinery?

***Leg layout.*** *Here I've laid out the leg locations in this half-scale model of my sawbench.*

## Build a Model

When I design a chair, I make a simple half-scale model using scrap wood and bendable wire. This method helps me visualize how the parts will look when I walk around the chair. The model also gives me all my resultant angles and sightlines without a single math equation.

I first learned this technique from Drew Langsner's "The Chairmaker's Workshop," a fantastic book. I then adapted his method to remove all math. Let's use it to design a sawbench.

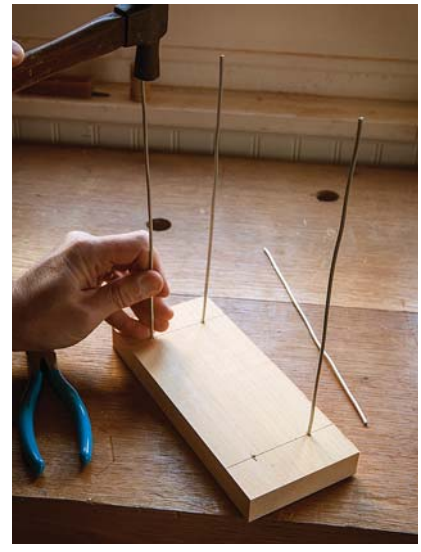
Take a piece of 3/4" pine and cut it to half the size of the finished sawbench. The finished top will be 2" x 7 1/4" x 17", so make your model 3/4" x 3 5/8" x 8 1/2". Next, decide where you want the legs and lay out their locations on the model. Each leg is located 2 1/2" from the end of the model and 1 3/4" from the edge. A lot of this is "by eye" so don't worry about it too much.

Now snip four pieces of 12-gauge wire to 10" long. (Note: You can also use wire coat hangers.) This wire will represent the legs of the sawbench. Drill a 5/32" through-hole for each "leg" on your model and epoxy the wire into the hole.

Now comes the fun part. Set your bevel gauge to 7° using a plastic protractor. Look at the model directly from the end of the board. Let's call this the front of the sawbench. Use needlenose pliers to bend the wire legs so they all splay out 7° from the top. Try not to manipulate the rake.

When they all match your bevel gauge, change the setting of the bevel gauge to 14°. This will be the rake. Look at the sawbench directly from its side and use your pliers to bend the legs to 14°. You might have to tweak things a bit so all the legs look the same.

Turn the model on its feet and look at the result. You will be surprised by how easy it is to spot angles that look wrong. Adjust the wires until they all look the same and the sawbench looks stable.



***Guided by wire.*** *The wire should be straight and strong enough that you can tap it into its hole on the underside of the model.*

***Make the rake.*** *Use the pliers at the base of the legs to bend them to 14° to match your bevel gauge.*



PHOTOS BY THE AUTHOR; ILLUSTRATIONS BY DAN PESSELL FROM THE AUTHOR'S MODELS

***When the tools align.*** *Rotate the sawbench model until the leg looks vertical compared to your try square. Adjust the bevel gauge until its blade aligns with the leg and square. Hold your head still and you will be surprised by how accurate this is.*

## Find the Sightline & Resultant Angle

Turn the model back over. Place a try square on the bench with the blade pointing to the ceiling. Rotate the model until one of the legs appears to be 90° in relation to the square. Place the stock of your bevel gauge against the long edge of the model and push the blade of the bevel gauge until it appears to line up with both the leg and blade of your try square. (Hold your head still.)

Lock the bevel gauge. This is your sightline. Place the bevel gauge on the underside of the model. Butt it against one of the legs and draw a line. You have found the sightline (by the way, it's about 64°).

Now find the resultant angle. Unlock the bevel gauge and place the tool's stock on the sightline. Lean the blade until it matches the angle of the leg. Lock the gauge. That is your resultant angle – it should be about 15°.

## SUPPLIES

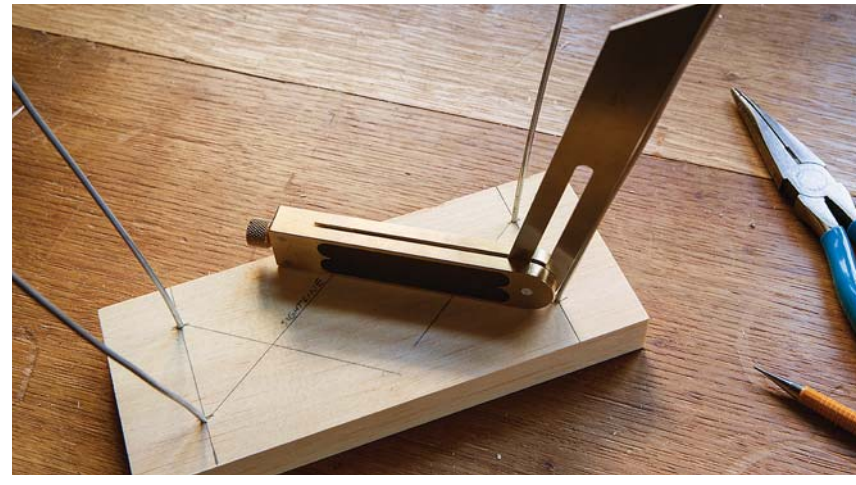
**Lee Valley Tools**
leevalley.com or 800-871-8158

1 ■ 5/8" Tapered tenon cutter
#05J61.09, $37.50

1 ■ Large standard reamer
#05J62.01, $26.50

*Prices correct at time of publication.*

***See the sightline.*** *Use your bevel gauge to draw in your sightlines on the underside of the model. You are almost done.*



***The result.*** *You just found the resultant angle. Paired with the sightline, you can build these sawbenches with great ease.*

## Build the Sawbench

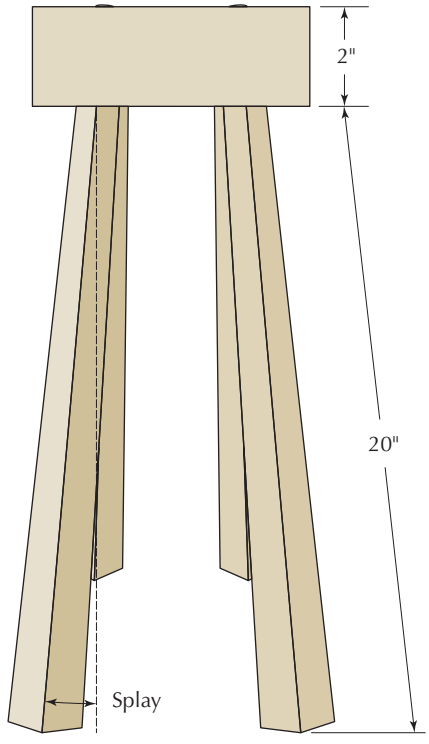
Building this quickie sawbench in a day will cement these concepts in your brain and give you a great workshop accessory. It also will introduce you to the basic ideas behind Windsor chair joinery.

I used pine for the top and oak for the legs. You can use other species, but I recommend a soft species for the top and a hard species for the legs. The top is 2" x 7¼" x 17". Cut the four legs to 1¾" x 1¾" x 22" and make them into octagons, either with a plane or your table saw. Taper the legs so they are 1¼" square at their tops.

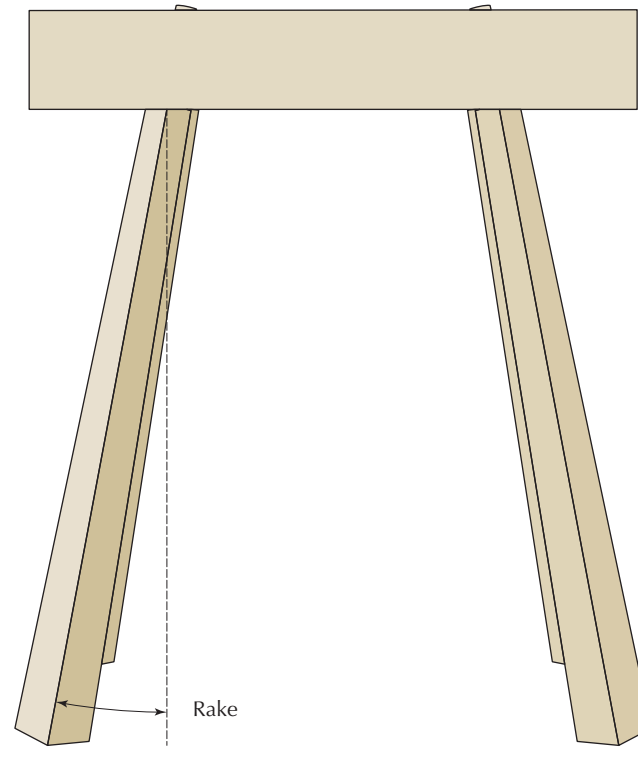
Now form the tenons on the tops of the legs. Rough in the tenon using a drawknife, or you can do this on the lathe. Each tenon should be 2⅞" long, 1⅛" in diameter at its base and taper to a little more than ⅝" diameter at the tip.

***Taper the legs.*** *You don't have to taper the legs, but they sure look a lot less like broom handles when you do. I taper legs with jack and jointer planes.*

***Shave those tenons.*** *A tapered tenon cutter makes this joint as easy as sharpening a (very large) pencil.*



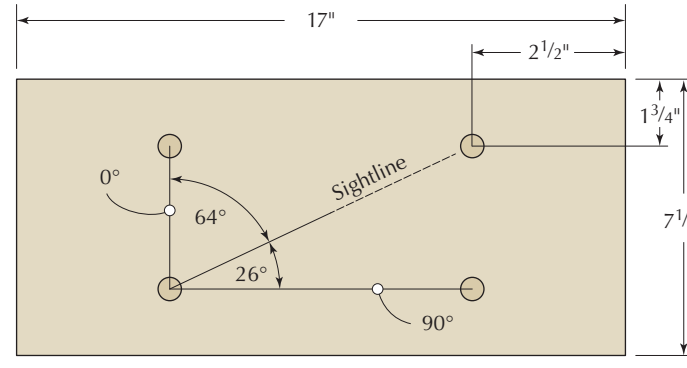

FRONT




SIDE

## Windsor Sawbench

| NO. | ITEM | DIMENSIONS (INCHES) T | W | L | MATERIAL |
|---|---|---|---|---|---|
| ❑ 1 | Top | 2 | 7 1/4 | 17 | Pine |
| ❑ 4 | Legs | 1 3/4 | 1 3/4 | 22 | Oak |




TOP – UNDERSIDE LAYOUT

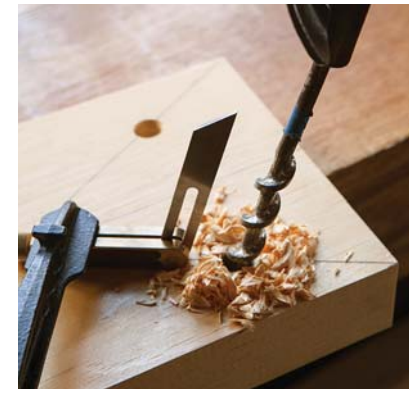
Now finish the shape with a 5/8" tapered tenon cutter. This inexpensive tool is available from Lee Valley Tools and works like a pencil sharpener.

## Make the Top

Use your model to lay out the location of the legs on your real sawbench and draw in the sightlines (64°) using a bevel gauge. Then reset your bevel gauge to the 15° resultant angle. Clamp it to the sightline and your workbench.

Chuck a 5/8" auger bit in your brace and plant your feet perpendicular to your sightline. Put the tip of the bit on the location of your leg mortise and tip the brace to match the resultant angle. Bore until the lead screw of the auger pokes through the other face of the seat. Remove the bit, flip the top over and finish the cut from the top of the sawbench.

***Ready to be bored.*** *Lay out the sightlines and leg locations on the underside of the top. I also drew in a centerline to confirm my sightlines and leg locations were consistent.*



***Nice resultant.*** *Use a spotter to help make sure you stay parallel to the blade of your bevel gauge. You'll outgrow a spotter eventually.*

## GOOD WOOD FOR STAKED FURNITURE

Many woodworkers have limited access to green, rivable stock. So when I started building staked furniture such as these sawbenches, I began with the assumption that you will buy wood from the local lumberyard or the home center. That translates to legs from red oak and seats from poplar.

Tulip poplar is soft, cheap, difficult to rive and can be found in thicknesses up to 4" at most lumberyards. It's fairly easy to work with hand tools and is quite paintable. So it's perfect for a seat or a tabletop.

For the legs you need something hard, readily available and cheap – red oak. You can buy tons of it for little cash, and it's readily available in 8/4, which is perfect for the legs of staked pieces.

For the leg stock, look for straight grain on both the face and edge of the board. And the straight grain on the edges is more important than the grain on the face. If you can find a board with straight grain on its edges, buy it.

What about moisture content? If you work with green wood, you ideally want bone-dry legs and slightly moist stock for the seat or top. That way the seat will shrink on the legs and tighten the joint.

If you buy your stock from the lumberyard, you might not have much choice about the moisture content of your wood. So don't worry too much about it. Buy your red oak. Cut it into 24" or 30" lengths and let it sit until you are ready to use it. You want the leg stock to be dry.

Right before you build your staked project, buy the poplar and get to work. Whether it's dry or wet, things will be OK. Just make sure the legs are at equilibrium before you get busy.

You might have other options in your area. Seats can be basswood, white pine or cedar. Legs can be white oak, maple (soft or hard), hickory, ash or anything harder than the seat and tough enough to take a hard knock with a mallet.

But don't let the available species stop you from building something you need. It didn't stop people during the last 500 years or so. —CS

Now ream this hole to a shape that matches the tenon. Lee Valley sells a matching reamer than can be used in a brace, electric drill or drill press. Ream the 5/8" holes until the tip of the reamer just fills the 5/8" exit hole on the top.

### Assembly

Assign each leg to a mortise and number the legs and holes. You want the annular rings of each leg's end grain to run parallel to the grain of the top. So twist the legs in their mortises until this is the case and make a mark that allows you to get back to that position after you have added glue.

Remove the legs and saw a 1"-deep kerf in the top of the legs to hold an oak wedge. The kerf in each leg needs to be perpendicular to the grain of the top (and perpendicular to the annular rings of the leg's end grain) so you won't split the top when you drive the wedges in.

To assemble, paint the joinery surfaces with hide glue (it's reversible), and drive in the legs with a mallet. Then flip the sawbench over. Paint the wedges with glue and hammer them into the kerfs in your legs.

After the glue is dry, level the wedged joints. Then level the legs (there's a short video listed below in Online Extras in case you need leveling instruction). I paint my sawbenches; they usually end up covered in paint eventually anyway as they make a great platform for finishing furniture.

That's really all there is to compound angles – the only math you'll do is counting all the additional things you can build with this skill. PWM

"It is the nature of all greatness not to be exact."

*—Edmund Burke (1729-1797), Irish statesman & philosopher*

*Christopher is the editor at Lost Art Press and the author of the forthcoming book "Furniture of Necessity," due out in 2016.*

***Matching tools.*** *The Lee Valley tapered tenon cutter and reamer have the same taper, which makes Windsor joinery a snap.*

***Locked.*** *Wedging the joint from above makes this a long-lasting joint.*

## ONLINE EXTRAS

*For links to all online extras, go to:*

- **popularwoodworking.com/jun15**

VIDEO: *See how to level the legs of a sawbench (and other furniture with legs) using simple tools.*

BLOG: *Learn how to cut wooden wedges on the band saw.*

WEB SITE: *Visit Country Workshops' web site for more information on chairmaking.*

TO BUY: *Drew Langsner's "A Chairmaker's Workshop."*

IN OUR STORE: *"Make a Windsor Chair with Mike Dunbar."*

*Our products are available online at:*

- **ShopWoodworking.com**

# Floating Table

BY BRIAN A. HUBEL

This handsome piece is simple to build and easily adapted to fit your stock.

A friend asked me to design and build a table using a special piece of walnut. I was given approximate measurements, but everything else was up to me.

I love the freedom these types of projects offer. While the table would be quite utilitarian, I knew it was going to be displayed as a piece of art, which meant very little clutter on its horizontal surfaces.

I wanted something slim, open and uplifting, nothing too heavy. The table would be visible from both the front and ends, so I decided to focus on the legs, which curve inward from the front and outward from the ends.

The shape "moves" as you travel around the table. This project is really an exercise in compound band-saw work with some exposed joinery for added interest.

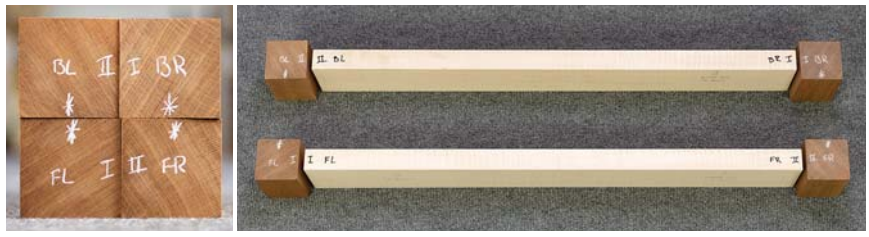
As with most projects, I start with stock preparation. In this case, I focused on the legs and aprons first, setting aside material for the top and shelf. It is well worth the effort to find 12/4 rift-sawn material for the legs, which will offer the most consistent grain on all sides.

Choose the legs and aprons for the best appearance, then mark their orientations in the build, as directed in the top-left picture on the next page.

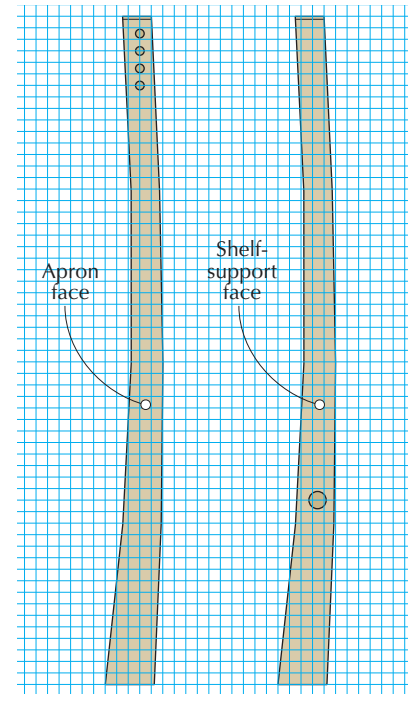
## Leg Template & Drilling Jig

Make a leg template from 1/8" material (see the patterns on the next page). Trace the leg profile on the two inside faces of each of the four leg blanks. Keep in mind when selecting the best faces that the legs curve inward when viewed from the front and curve outward when viewed from the end.

PHOTOS BY LAUREN ALLEN




***Legs & aprons.*** *The FL, FR, BL and BR designate the Front Left, Front Right, Back Left and Back Right leg and apron positions. The Roman numerals I and II identify the leg-to-apron junction, as well as the drilling-jig orientation. The asterisk denotes the face of the leg that will eventually receive the shelf-support dowels.*




LEG PATTERN
One square = 1/2"

Now that you know the relationship of legs to aprons, shift your attention to fabricating the drilling jig. The drilling jig establishes the location of the dowel joinery that will connect the legs to the aprons. If you've ever attempted doweling before, you know what an exacting process this needs to be. Making an accurate drilling jig, and, more importantly, maintaining correct orientation when in use, is key to proper dowel alignment between legs and aprons.

I used a scrap block of bubinga, but any dense hardwood that will withstand repeated drilling operations will suffice as the drilling guide. Cut your block 3¾" long, 1½" wide and 2" high. At the drill press, clamp a straightedge to the table 1" back from the center of a ⅜" drill bit. Starting ¾" in from either end of the block, drill four holes in a straight line down the length of the block spaced ¾" apart on centers. It's more important that the holes run in a straight line than be exactly spaced. During use, the jig will compensate for holes not drilled precisely ¾" apart, as long as the jig is positioned the same for both the leg and mating apron.

After drilling the block, attach an auxiliary fence (I used ½"-thick MDF, 3¾" wide and roughly 4" long) to the side of the jig that was against the straightedge at the drill press. This maintains the 1" offset. A little glue and some brads are all that are needed to secure the fence to the block.

The fence aids in accurately locating the jig on the legs and aprons, and provides a clamping surface during use.

With the drilling jig fabricated, I mark one end of it with "I" and the opposite end "II." These Roman numerals correspond to the marks on the legs and apron to ensure proper jig orientation during the drilling process.

## Drill for Dowels

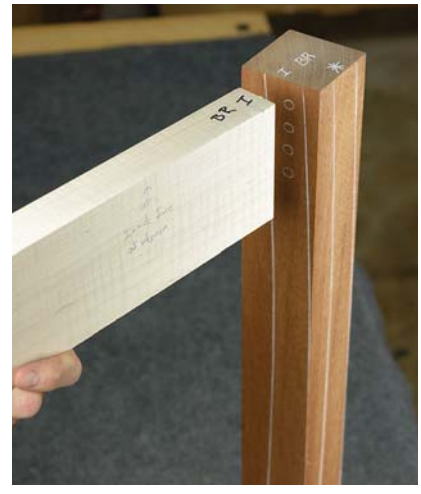
Start by drilling the legs to receive the apron. Place the drilling jig in the proper orientation with the auxiliary fence on the inside of the leg and the top of the jig flush with the top of the leg. Clamp and drill all four holes to a depth of 1¾" using a ⅜" drill bit with a stop collar in order to achieve a consistent depth.

The process is repeated on the aprons with a few adjustments.

You need a ¼"-thick spacer taped to the inside of the jig's auxiliary fence to shift the hole location close to center on the apron.

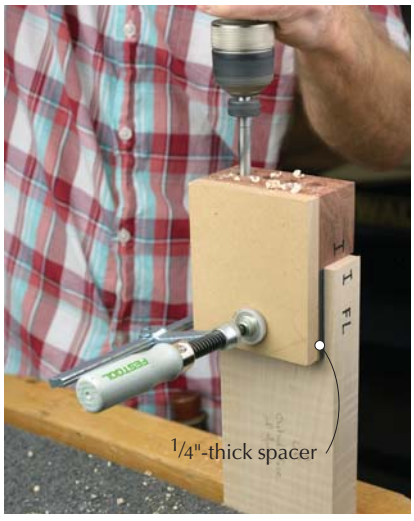
And this time, the bottom of the jig should be aligned flush with the bottom of the apron. This will result in the apron standing proud of the jig by ¼" at the top. This establishes an offset between the top of the leg and the top of the apron. To maintain correct orientation, the jig's auxiliary fence should be clamped to the outside of the apron. Clamp and drill all four holes to a depth of 1¾".

The last bit of dowel joinery – the support for the shelf – can be accomplished at the drill press with a ¾"-diameter bit. Mark the location off the leg



***Leg layout.*** *Trace the leg pattern and drilling locations on the two inside faces of each leg blank to help set things up for successful joinery.*

***Jigged up.*** *The drilling jig imparts accuracy and repeatability as you drill 1¾"-deep ⅜" holes in the legs and aprons.*




***Apron holes.*** *Place a 1/4"-thick spacer between the fence and apron and align the jig with the bottom edge of the workpiece.*

template on the inside face adjacent to the apron holes. Drill 1 1/4"-deep 3/4"-diameter holes using a Forstner bit at the drill press.

## Shape the Legs

With the leg joinery cut, it's safe to proceed to the band saw to cut the square legs to their final curved shape. Because all four sides of each leg are curved, this operation requires cutting the profile from two adjacent faces of the leg, just as with a traditional cabriole.

Make the first set of cuts with the dowel holes for the apron facing upward, just leaving the pencil line as you cut. Then tape the waste material back in place on the concave side of the leg and redraw the leg profile on the opposite convex side of the leg. (This should be the side with the 3/4" hole for the shelf support dowel.) Back at the band saw, make the remaining cuts.

Clean up the band-sawn faces and fair all the curves down to the pencil lines. To fair curves on the inside/concave surfaces, I like to use a small belt sander I've modified by inserting a thin, slightly curved shim between the platen and sander body, creating a gentle outward curve on the sole of the sander.

I clean up the outside/convex leg surfaces on a stationary belt sander by continually rocking the legs over the belt.

When you think you have all the faces complete, sight down the length of the leg at each corner. If you did a good job, you should see a crisp line down the length of each corner.

Further shaping can be done by rounding the corners down the length of the legs. You may choose, as I do, to have a smaller radius at the top and a larger radius at the bottom, say 1/8" and 3/8", respectively. There is nothing scientific about this. Just sand, rasp, spokeshave or plane until you are happy with the look and feel of the legs. (Care should be taken not to encroach too much on the dowel locations.)

I also use a block plane to chamfer the tops of each leg, then carve in a texture in the chamfered areas using a small carving gouge.

## Make the Aprons

Before shaping the aprons, there's some joinery to wrap up while the material is flat and square.

First, cut two dados on the inside face of each apron to accept the cross-members that support and anchor the tabletop. These dados are located approximately 4" in from the ends and are 7/8" wide x about 3/4" deep. I cut these with a dado stack at the table saw.

Now dry-fit the aprons to the legs to scribe some lines to the fitted apron so you can shape it to match the leg profile when viewed from the front and the ends.

To do this, I use four dowels sanded slightly undersized and long enough to yield a gap of 1/16" between the apron and leg at the tightest point when seated. Using a compass, transfer the shape of the leg to the face of the apron. Make certain that the dowels remain seated during this procedure, clamping if necessary. Separate the assembly, cut to the scribe line at the band saw and clean up the cut.

Now you need to angle the front of the apron. Dry-fit the apron-to-leg assembly as before, and scribe the ends of the apron to match the leg profile. You only need to scribe from the outside face of the leg to the ends of the apron.

Tilt the band saw table to closely match the angle of the scribe lines. Due to the band saw work and hand work already performed on the legs, you can expect some variations when setting the angle to the scribe lines. Go with an average and you can make adjustments later, if necessary.

***Cut multiple curves.*** *To cut curves on all four faces, the trick is to saw right at your layout lines, then tape the offcuts back in place as you make the second cuts. This keeps the workpiece square and makes things safer and easier.*

***Sander finesse.*** *A slightly curved shim inserted between the platen and sanding belt on a small belt sander allows the machine to be used to fair gentle inside curves (left). For outside curves, I rock the legs on a stationary belt sander (right).*

***Face first.*** *Dry-fit the legs to the apron then transfer the leg's curve to the apron. After cutting, reassemble the dry-fit and transfer the leg shape to the ends.*

Cut to the scribe line on the outside face of the apron. Now you can see the importance of the dado depth: too deep and it will break through the face; too shallow and you'll begin to remove a portion of the dado on the inside face of the apron during the next shaping step.

Clean up the sawn face at the jointer or by hand with a plane. Pass the piece through the planer or drum sander at an angle, with the freshly dressed face down. Angling the apron during this process helps compensate for the dado voids so there's constant pressure on the workpiece as it passes through the cutter/sanding head. Make continuous passes until the inside face is parallel to the outside face.

Test-fit once again and make adjustments as needed with a handplane. The goal is to have the apron face closely parallel with the leg profile and recessed by approximately 1/16" so the leg stands slightly proud of the apron. With the inside face, aim for similar results, but don't fuss too much; it's on the inside.

One final bit of apron shaping remains—the arch on the top and bottom to accentuate the floating top.

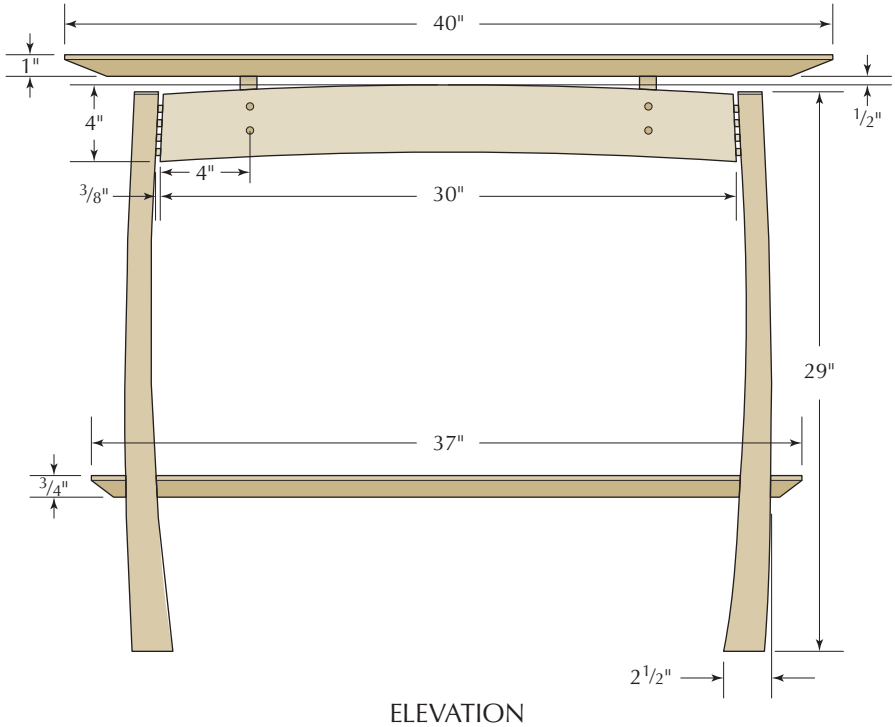
Lay out the curves (the arch rises 1/2" in the center at the top and bottom) with a drawing bow and make the cuts at the band saw with the table tilted at the same angle you cut the face of the apron; that ensures the edges will be in the same plane as the top.

## Fabricate the Cross-members

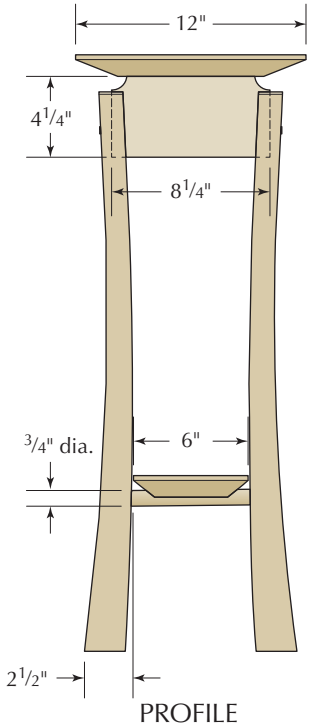
The distance between the front and back apron to this point is variable and ultimately determined by the cross-members that fit into the dados. The defining component here is the width of the top. In my case, the cross-members ended up 8 1/4" long, which yielded a overhang of roughly 1" front and rear with a 12"-wide top. Your sizes may vary.

The cross-members stand slightly taller than the highest portion of the apron (about 1/2"), causing the top to "float" above the apron. They also serve as a means to attach the top to the base.

***On edge.*** *Tilt your band saw table to match as closely as possible the scribe line on the apron ends, then cut.*




ELEVATION




PROFILE

After milling the pieces to size, you'll drill a series of holes in the bottom edge of each cross-member. The cross-members will be secured in the dados with screws, but because end grain doesn't offer adequate screw-holding power I also insert a "cross-dowel" to improve the screw joints.

These 1/2" holes are located approximately 1/2" from the ends of the cross-members, and should be about 3" deep. Glue and insert 1/2" hardwood dowels.

Adjacent to these cross-dowels, you'll bore an oversized stepped hole, about 3" deep, to accept the #10 x 2" screws that will attach the top. The oversized hole allows movement for seasonal expansion and contraction cycles. Oversized pan-head screws (also called washer-head screws) come in handy here, spanning the gap created with the oversized stepped hole.

You also need to drill two 3/8" pilot holes along the centerline of each apron dado to secure the cross-members.

After drilling those pilots, chase them with a 3/8" Forstner bit to yield flat-bottomed holes to accept pan-head screws during assembly (I prefer pan-head screws because they don't sink into the material). Drill just deep enough to accept the heads of the screws, plus the plugs to be installed that will cover them.

You're ready shape the cross-members to match the profile of the aprons.

Dry-fit the entire apron assembly. Trace the profile of the apron top, and bottom, onto the end grain of the cross-members. Also transfer the apron screw locations to the cross-members so you can drill pilot holes.

***On a curve.*** *A thin offcut makes an excellent bow for laying out curves.*

The slight bevel on the bottom edge of the cross-members is easily cut at the table saw. The top side requires a little more effort. To accentuate the floating top, cut a curve at the top corners of the cross-members so they are not as visible. The band saw is a good choice for this operation. Be sure to tilt the table to match the scribe line from the apron. Leave your pencil line, then sand to it during clean-up.

***Stepped holes.*** *At the drill press, drill stepped holes to accept the screws that will attach the tabletop to the cross-members.*

***Profile transfer.*** *Dry-fit the pieces then transfer the shape of the aprons to the end grain of the cross-members.*

With a thin shim taped to the table of my oscillating spindle sander, I clean up the cut, testing the fit as I go so as not to remove too much material. The shim creates the angle needed to match the scribe line.

## Assembly Time

After a final sanding of all the workpieces, you're ready for some assembly.

I start by applying a light coat of yellow glue to the end grain of the cross-members, waiting a minute then reapplying. (This "sizing" allows the end grain to absorb some glue for better end-grain adhesion so the joint is not starved.)

Now apply a thin coat of glue to the dado and position the cross-member, running screws in place to act as permanent clamps. I do one apron (two cross-members) at a time.

With the screws in place, cut ebony plugs with a 3/8" plug cutter for the countersunk screw holes. Apply a little glue in the hole, tap in the plugs, saw off the excess and plane flush.

After the glue dries, if needed, attend to any final sanding and shaping of

## Floating Table

| NO. | ITEM | DIMENSIONS (INCHES) T | W | L | MATERIAL | COMMENTS |
|---|---|---|---|---|---|---|
| ❑ 2 | Aprons | 1 1/2 | 4 | 30 | Maple | |
| ❑ 2 | Cross-membes | 7/8 | 4 1/4 | 8 1/4 | Maple | |
| ❑ 4 | Legs | 2 1/2 | 2 1/2 | 29 | Sapele | Rift-sawn |
| ❑ 1 | Top | 1 | 12 | 40 | Walnut | |
| ❑ 1 | Shelf | 3/4 | 6 | 37 | Walnut | |
| ❑ 2 | Shelf supports | 3/4 dia | | 2' | Walnut | Cut to fit |
| ❑ 16 | 3/8" dowel | 3/8 dia | | 4' | Maple | Cut to fit |
| ❑ 8 | Plugs | 3/8 dia | | 1/4* | Ebony | |

*Length is approximate; cut to length as needed.

***Angle-ease.*** *A thin shim on the oscillating spindle sander's table lifts the cross-member to the desired angle.*

***Screw & plug.*** *After sizing the end grain and gluing the cross-member in its apron dado, add screws immediately; they act as clamps. The screws are covered with ebony plugs.*

the cross-members to make a smooth transition into the apron.

Now direct your attention to the legs. First, you need to cut and fit dowels to connect the legs to the apron. The fit of these should be snug, but not so tight that you can't insert and remove them by hand. The dowel length should be enough to yield a 1/4" to 3/8" gap between the leg and apron.

After cutting the dowels to length, sand them at the drill press for a precise fit. I also flute the first 5/8" or so down each end of the dowels using a fluting dowel plate. Fluting offers some additional bite and space for excess glue. And finally, I chamfer the ends of each dowel to ease assembly and offer a space for excess glue.

Dry-fit and clamp the legs to the apron assembly.

Now measure for 3/4"-diameter dowels that run from the front legs to the back legs to support the lower shelf. This is easily accomplished by inserting two short sticks or dowels into the holes and marking a line across both pieces. Remove them, realign your mark, then measure the overall length. Repeat at the other end. If you discover discrepancies from end to end, take an average and cut to that measurement. Cut the dowels to length, then sand, flute and chamfer as before. A 3/4" dowel exceeds the capacity of my fluting plate, so I use a V-gouge to score/flute the ends.

"The details are not the details. They make the design."

*—Charles Eames (1907-1978), American designer*

***Sand & flute.*** *If your dowels are too snug for a press fit, chuck them in the drill press to sand. Then use a fluting plate to flute the first 5/8" or so for a better glue grip.*

Dry-fit the leg assembly one last time to make sure you're happy with the joinery fit and that you are familiar with the assembly sequence.

I start the gluing process with the lower shelf support dowels in the legs. Apply an even coat of glue to the hole and a very light coat to the fluted sections of the 3/4" dowels. Assemble and clamp, making sure the legs are parallel with one another and not spun or skewed around the dowel.

Dry-fit the legs to the apron assembly to help keep things in their proper places. (It's easy for clamping pressure to toe the legs; the dry-fit overcomes this.)

This is also a good time to drill holes for and insert 1/8" bamboo pins to lock the shelf-support joints in place. The pins can be on the inside or outside of the leg, or can pass completely through the joint if desired.

To begin the leg-to-apron assembly, start by gluing four dowels into each leg. Squeeze-out is difficult to clean up here, so don't get carried away with the glue. A good coat applied with a bamboo skewer to the inside of all the holes, along with a very light coat to the tip of the fluted portion of the dowels, is all that is needed.

Drive each dowel with a steel hammer until you hear and feel them bottom out.

***Pin it.*** *With round joints, consider adding a small pin to keep things from rotating. A bamboo skewer works well as a pin.*

***Aligned.*** *After driving the dowels, make sure they're all the same height before proceeding.*

***Safe cuts.*** *A carriage safely supports the workpiece at the desired angle (in this case, 7°) as you make the cuts on the end grain.*

Using a straightedge, make sure all four dowels in each leg are aligned perfectly even in height. If one or more is tall, you need to hammer it in farther or cut it to align it with the others. If they don't match, your aprons won't seat properly.

Now you're ready to attach the legs to the aprons. Start by taping 1/8"-thick Baltic birch strips to the outside of each leg to protect them while clamping. And have a dead-blow mallet and clamps at the ready.

Dry-fit one leg to the apron assembly. Working quickly, glue all eight holes on the opposite end of the apron assembly in the same fashion as before. With the glue applied, tap the assembly together with the mallet. If the dowels don't fully seat, pull the ends into final position with the clamps.

After the glue sets, repeat the process on the other end.

## Get Horizontal

The substructure is now complete, so it's time to turn your attention to the tabletop and shelf.

For this table I dimensioned my friend's claro walnut that was thick enough to re-saw and bookmatch for both the top and the shelf.

With your top cut to size, undercut the long edges at the table saw with the blade tilted to 40°. The ends are also cut at the table saw, using a shop-made carriage to safely support the top turned on end. The carriage is angled at 7°; the blade is at 90°.

After some sanding and easing of the corners, you're ready to attach the top. With it upside down, center the base front to back and side to side. Mark the screw locations with a brad-point bit. Remove the base, drill the pilots and screw on the top.

The shelf will receive the same undercut treatment as the top, however, the width still needs to be determined. Due to variations in band-saw work and hand shaping, some measurement discrepancies should be expected, so use an average.

Measure the distance between the legs just above the lower shelf-support dowel on both ends. From this measurement, subtract 3/8" to allow for a small gap between the shelf and leg. This is the final width for the shelf.

After cutting the shelf to size, center it on top of the supports and mark the location of the dowels on the underside of the lower shelf. With a 3/8"-radius core-box bit at the router table, rout a cove on the underside of the lower shelf to receive the support dowels.

Finally, drill two slightly countersunk holes from the underside of each shelf-support dowel, drill pilot holes in the shelf, then screw it in place.

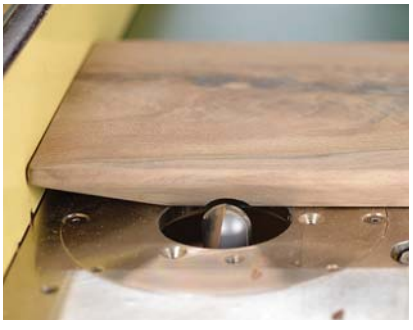
Now inspect the project and do any final sanding by hand, making sure to clean up any glue squeeze-out so it doesn't interfere with your finish.

For this finish on this piece I used an equal mixture of urethane, tung oil and mineral spirits.

Flood the surface and wipe off all excess after allowing the varnish to soak in for a few minutes. After the first coat has been allowed to dry for a couple of days, sand lightly with #400-grit stearated sandpaper and repeat the process.

I typically apply two to three coats of the varnish followed by a light coat of full-strength urethane.

Once the finish is complete and dry, screw the top and shelf in place, and you're done. **PWM**



***Furrow.*** *A core-cox bit at the router table cuts a curved recess in the bottom of the shelf for the shelf-support dowels.*

*Brian is a Colorado-based professional furniture maker who specializes in custom work with an Asian flair. You can see more of his work at brianhubel.com.*

## ONLINE EXTRAS

*For links to all online extras, go to:*

- **popularwoodworking.com/jun15**

SLIDESHOW: *Watch a slideshow of the many step photos the author shot for this build.*

PLAN: *Download the SketchUp model for the Floating Table.*

WEB SITE: *See more of Brian Hubel's work on his web site.*

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ARTICLE: *Read "How Tables Work," an article from the April 2010 issue to help you design the perfect table for your needs.*

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# Gravity by Design

BY DARRELL PEART

Small changes to details make a big difference.

***Blank bottom.*** *Here's what my reproduction of Greene & Greene's Thorsen House sideboard looks like, minus the design details employed by the Greenes.*

***Bulk & delicacy clash.*** *Without further manipulations of the design, the delicate inlay on the door panels appears out of place in contrast with the bulk of the overall piece.*

Several years ago, I took a different approach to design – one that relies less upon ratios and mathematical formulas and more upon intuition and observation. I have written about this previously and have referred to it as my "Design DNA" scheme. Within this framework, one of the early things that caught my attention was the interaction of a design with gravity. Nature has been dealing with this since the beginning of time.

Observe the differences between a bulldog and a greyhound. The greyhound is built for speed and is light and airy. The bulldog is built for brute strength and is muscular and stout. Each of these dogs has a much different relationship to gravity.

With the idea of gravity in mind, the bottom portion of a design proves most interesting and telling. This is where gravity and design directly interact: where wood the meets the floor.

What goes on here has a profound effect on the design as a whole. At this point opportunities to enhance or tweak the design are ripe. With that in mind, a word of caution though: Tweaking the details can push or pull a design in one direction or another but there are limits; a design's basic nature must still be honored.

My DNA and gravity schemes are not lost ancient truths or anything of that sort – they are merely analogies I use to help me visualize things. They have aided me immensely and given me means through which to create new designs and understand classic works.

My focus during the last several years has been the work of Charles and Henry Greene. It is widely believed that Charles was the driving force behind the designs. In my estimation, he was a genius and a master of the smaller details.

During the course of their careers, the Greenes created countless details, all of which were placed and used with profound forethought. Charles was in complete control of the design and called upon every detail to pull its weight and more. His work is not unique in its manipulation of the smaller details for a greater purpose, but it is a good starting point from which to study.

Several years back, I had the good fortune to reproduce the Greene & Greene Thorsen House sideboard. The great thing about reproducing a masterful design is that you immerse yourself in the smallest of details – an invaluable learning experience.

During the project, one thing that stood out was the detail treatment of the lower rails and bottom of the legs. The genius of Charles was on full display here. His manipulation of the smaller details had a profound effect upon the design.

The other pieces in the Thorsen dining room had refined features, highlighted by delicate inlay. I think the challenge Charles faced was to lighten the mass of the sideboard so it would work well alongside its companion pieces. It was the smaller details at the lower end of the piece that provided him with the opportunity to make it happen.

## Thorsen Sideboard & Gravity

Let's start with a blank slate and see what the sideboard looks like without any inlay or other treatment in the lower area (above, left).

Now let's add the inlay to the design (above, right).

To my eye, the inlay seems slightly out of place. The design, as is, is a bit "heavy" to co-exist with the delicate inlay.

Now, lets incrementally add back the details Charles used to manipulate the design. First, we'll deal with the bottom of the legs just below the lower rails. By tapering them in at this point it subtly suggests to the eye a less weighty mass. Think of pieces you have seen with tapered legs that come to almost a point. The more narrow and pointy the legs, the less visual weight is supported.

> "The whole construction was carefully thought out; there was a reason for every detail. The idea was to eliminate everything unnecessary, to make the whole as direct and simple as possible, but always with the beautiful in mind as the final goal."
>
> *—Henry Greene (1870-1954), from* The Craftsman, *Vol. 22, Aug. 1912*



PHOTOS BY THE AUTHOR EXCEPT WHERE NOTED

***Subtle light.*** *A tapering-in at the very bottom of the legs subtly "lightens" the design.*

***Strength & light.*** *The addition of cloudlifts to the top side of the rail removes mass and serves to further lighten things up. Conversely, the upturn preserves the necessary visual strength at the point where the legs and rails meet.*

***Mass removal.*** *The cut-out slots are an especially clever device and illustrate Charles Greene's true mastery of design. Again, by removing mass the design is "lightened up." The arrangement of the slots with the larger one on the bottom brings to mind a supporting pedestal, which visually enhances weight and strength.*

The implication is that the piece has less actual weight. The small tapering at the bottom of the sideboard legs does not shout its effect, but mentions it quietly, almost on a subconscious level (top, left).

Let's move on to the lower rails. This is where Charles really shows his mastery of design. There is danger here, though – the knee-jerk reaction is to simply make the rails narrower to lighten things up. This will, in fact, lighten things up, but it will also leave the solid mass in the upper portion of the design with inadequate support. The rails will appear anemic.

Charles did what might sound like a paradox: he narrowed the rails while at the same time leaving them wide. By inserting a cloudlift on the upper edge, he allowed the full width of the rail to remain unchanged at the point of joinery with the legs. This preserved the necessary support. But the cloudlift downturn removes material and makes the rail narrower, thus lightening things up a bit (at top, right).

Double slots in the rails are a very simple detail with a powerful purpose: They are an incredibly clever device that again adds both visual lightness and strength. The negative space they produce takes away mass and considerably lightens the rails visually (left).

Observe the configuration of the slots, though, and put the image of a multi-tiered pedestal in your mind.

The tiers of the pedestal start large at the bottom and reduce in size as they go up. The tiers on the bottom are supporting more weight and must be larger. We are accustomed to this arrangement, so it is natural that our minds would subconsciously read slot arrangement on the rails as one that adds strength and support.

It might be worthwhile to look now back at the first photo and compare it to the photo at left. The three little details at the bottom of the piece together have a profound effect upon the design.

## Waterfall Detail

A common bottom-of-the-leg treatment is to taper the legs on the two inside edges to a narrow point at the floor.

***Width reads as strength.*** *The pedestal on these classical columns (at the Supreme Court Building in Washington, D.C.) has wider tiers at the bottom to support more weight. Our eyes are accustomed to this arrangement and so subconsciously read it as so.*

SUPREME COURT PHOTO © FSTOCKPHOTO

***Reversal.*** *Observe the reverse taper on the legs of the Gamble House master bedroom game table. My "gravity" scheme was the key to understanding this detail. Note the larger upper step on the waterfall detail here compared to the Gamble House's master bedroom chair below.*

This facilitates an illusion of lightness by suggesting that gravity does not have a strong hold on the piece and minimal support is needed. It suggests a lighter-than-air feel.

The Greenes used a variation on this approach for the furniture of the Gamble House's master bedroom. As usual, their version is subtle; the taper detail features two unequal steps at the bottom of the leg. In typical Greene & Greene fashion, each step begins with a roundover to soften the transition. I call it a "waterfall detail."

But here is where it gets a bit curious. The unequal steps are reversed on some pieces. As someone who assigns a lot of meaning to these things and who think the Greenes had a reason for everything, this drove me a bit crazy.

My gravity scheme was again the key to help my personal understanding of this detail. After considerable observation (and gnashing of teeth), one thing that caught my eye was the reverse taper of the Gamble House's bedroom game table legs. This caused more teeth gnashing, but it also provided me with the explanation. The image that came to mind was gravity in a sort of liquid form flowing through the legs. In the real world the legs actually do support the entire weight of the piece. So with liquid gravity exerting pressure downward through the legs, it hits a constriction at the waterfall detail and backs up, causing a bulge and the reverse taper.

So applying this to the taper itself, each piece has a perceived weight above the ground. The more weight, the more pressure downward. The taper restricts the flow and puts the brakes on. With more weight and momentum the initial braking action takes longer, making the first step the larger one. When I applied this thought to all of the pieces in the room I was able to predict which ones had shorter and which ones had longer first steps.

## Blacker Leg Indent

Let's look at another classic detail: the indent found on many of the legs in the Blacker House.

The detail itself is unique to Greene & Greene, but the concept is not. The indent narrows the leg for a short distance, then stops. Were the narrowing to continue, the effect would be similar to the waterfall detail.

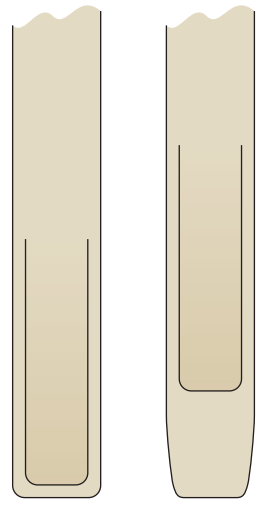
But by stopping before the end, the effect is quite different. The weight is visually deposited in the space directly below the indent. That bottom portion of the leg is thus visually receiving the entire weight of the piece.

For the detail to work, there must be a sufficient amount of mass below the indent to visually support the given weight. The slight roundover and taper below the supporting mass serves to visually contain the weight and not let it dissipate. View the difference without the indent detail (above right).

***Lift up.*** *The side chair in the Gamble House bedroom is lighter in visual weight than some of the room's other pieces; the upper waterfall step is smaller in comparison to the game table shown above.*

GAME TABLE & SIDE CHAIR PHOTOS COURTESY OF THE GAMBLE HOUSE

***Blacker indent.*** *Here's the leg indent detail as seen on my reproduction of the Blacker House living room side chair. The visual weight of the piece is contained in the mass just below the indent.*



***Detail drawing.*** *On the left, the indent continues to nearly the bottom of the leg and without any tapering at the end. This directs the visual weight to the bottom without providing a place for it to reside. On the right, the mass below the indent receives and gathers the weight of the piece. The taper at the bottom mitigates the weight in a sort of upward push.*

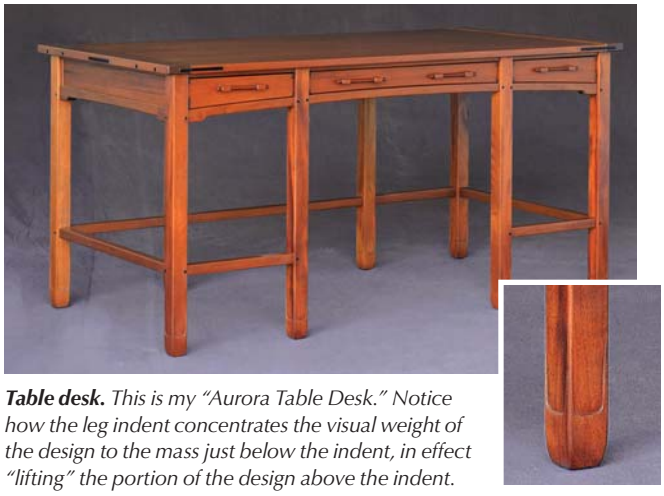
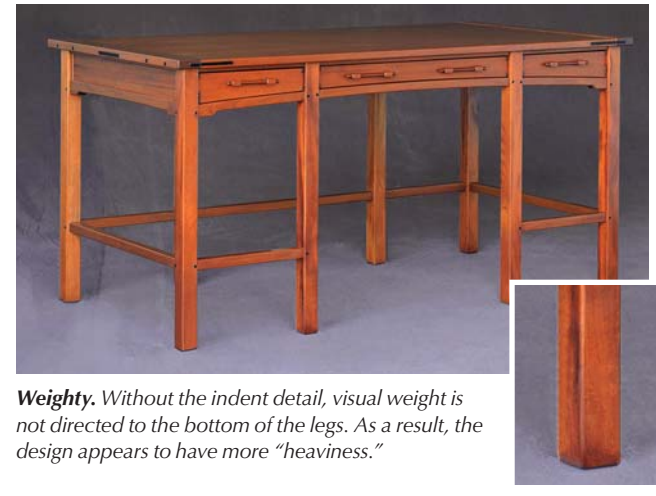


***Table desk.*** *This is my "Aurora Table Desk." Notice how the leg indent concentrates the visual weight of the design to the mass just below the indent, in effect "lifting" the portion of the design above the indent.*



***Weighty.*** *Without the indent detail, visual weight is not directed to the bottom of the legs. As a result, the design appears to have more "heaviness."*

***Ancient Egypt.*** *Manipulating and directing visual weight is nothing new. Here we see an Egyptian chair circa 1479-1743 B.C. The weight of the piece is directed to the bottom of the legs where the feet sit upon a supporting member.*

***Newport, R.I.*** *In the ball-and-claw detail of this classic Newport card table (circa 1760-85), the leg narrows then flares out at the bottom. The claw seizes the ball in an iron grip and the visual weight of the piece is transferred to and contained in the ball.*

EGYPTIAN CHAIR & CARD TABLE PHOTOS © THE METROPOLITAN MUSEUM OF ART. IMAGE SOURCE: ART RESOURCE, NY

This basic concept has been used for thousands of years, as far back as the Egyptians. But skip ahead a few millennia and the concept is still in use with the classic ball-and-claw foot.

## The Strap Detail

The strap detail is something I came up with originally to enhance the visual weight of a desk I was working on.

This piece was meant as pedestal version of my Aurora Table Desk, on which I employed the Blacker leg indent to further enhance the piece's inherent lightness. The pedestal desk was a different story though. With its abundant heft and mass, my approach had to be much different. The difference in these two desks could be a subject in itself, but for our purposes here we will focus on the strap detail that adorns the base (below).

First, I'll back up a bit and give some background on the strap detail itself. The Greenes produced a small letter box for the Ford House that had protective leather straps underneath that were attached at the top of the base. This idea struck me as useful for another purpose.

In my scheme, the straps were not leather, but wood. Their purpose is to visually anchor the design to the floor. I see the straps as the visual representation of gravity at work. When the load is immense, the straps, as gravity's agent, reach up and pull down. This, in effect, visually enriches the weight and heft of the piece.

Placement of the straps became an issue, though. The key is to develop a mental image that defines the visual purpose. This relates back to my DNA idea.

In this case, I started with the notion of the straps being employed to lift things. I further defined the concept by envisioning a longshore dock a couple hundred years ago, where straps are used to lift crates off the ships. In placing the straps, I asked myself where they would be positioned to equally share the burden. Again, gravity is at work here but instead of lifting, it's pulling down and enhancing the illusion of heft.

Now have a look at image on the bottom for the desk without the strap detail. To my eye, it doesn't seem as grounded.

## Conclusion

Careful thought must be given to how a design interacts with gravity. A critical point is where the design meets the floor, which provides ample opportunity for fine-tuning. Seemingly small changes can have a profound effect upon the character of a design.

The mental images I use may or may not work for you – if they don't, find ones that will. Seek out designs that appeal to you and give careful thought to what makes them succeed. Learn to observe the details and practice what you have learned. Use your imagination. With time and practice, you'll learn to let your intuition be your guide. **PWM**

*See more of Darrell's work and read his blog at furnituremaker.com.*

***Pedestal desk.*** *The "strap" detail on a pedestal version of my Aurora Desk enhances the substantial weight of the piece by visually anchoring it to the floor.*

***Sans strap.*** *Without the "strap" detail, the pedestal desk design lacks solid anchoring.*

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# Plain Matted Chairs

## This humble form has a long legacy and modern descendents.

In a recent column, I made reference to my initial foray into woodworking as a chairmaker. Post-and-rung, ladderback, slat-back – these chairs have lots of names in various places and in different periods. I learned how to make them at a shaving horse, shaving the parts to generally cylindrical shapes with drawknives and spokeshaves.

Jennie Alexander's book "Make a Chair from a Tree" was the textbook at the time (1978). It mentioned and briefly discussed traditional forms, then went into the how-to of it, with particular attention to the moisture content of the chair's rungs and posts. This was the key to the chair's success; the slightly higher moisture content of the post would eventually drop, leading the post to shrink onto the drier rung. In detail, the rung even picked up moisture; leading to a very tight joint.

She spawned several generations of chairmakers. When I think of how many of these chairs have been made over the years in various workshops, classes, from the book and eventually from the "Make a Chair from a Tree" video, it's amazing.

***Art evidence.*** *Dutch genre painters recorded in great detail many aspects of daily life of the middle and lower classes. Here is a clear view of a shaved plain chair with a rush seat from 1660s Netherlands.*

***Plain matted.*** *This humble form, referred to in London records as a "plain matted chair," features shaved, not turned, parts.*

I went on to focus my work on the reproduction of 17th-century forms, which sometimes included all kinds of chairs. The elaborate and impressive ones are those that usually get attention in museums, private collections and in the antiques market. But for a minute, forget those "great" chairs in inventories, whether they be wainscot chairs, upholstered examples or even the turned chairs such as Governor Bradford's chair at Pilgrim Hall in Plymouth Massachusetts.

### Humble Seats

It's the more humble and seemingly insignificant chair that I am interested in right now; one London record referred to "plain matted chairs." Huh, what's that mean?

A Feb. 20, 1615, record from the Worshipful Company of Turners of London discusses the seizure of goods made by foreign turners working in the City; these could be confiscated and sold, with the proceeds going to the Company. Ah, the good old days.

Anyway, the record cites prices for "turned matted chairs" and "plain matted chairs." To my ear, the difference is between turning and not turning the parts of the chair. When we shaved our chair parts with Alexander, we were one step short of turning them; the preparation for turning is to shave the riven parts into octagonal stock, then mount them on the lathe to finish shaping them into round bits.

So, what does a plain matted chair look like? Like the one in the opening image: square posts, shaved rungs and mostly round-ish. There are two or three slats between the rear posts. The seats are typically woven rush in old

CONTINUED ON PAGE 61

PHOTOS BY THE AUTHOR; DETAIL FROM "PEASANTS IN AN INTERIOR," ADRIAEN VAN OSTADE, 1661, USED COURTESY OF THE RIJKSMUSEUM, AMSTERDAM

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CONTINUED FROM PAGE 58

***French-Canadian.*** *This shaved chair, probably Canadian/northern New England, looks older than it really is. An ancient form made right into the 20th century, it has a timeless beauty. This style of chair served many cultures for centuries.*

ones, with some bark seats found, too.

We see these in abundance in Dutch paintings of the 17th century; Dutch artists were great at depictions of the middle and lower classes, and the detail is often excellent. That is a good thing, because these common, lower-class chairs survive in inverse proportion to the quantities that were most likely made.

A few with early histories are known and found in public collections, but these chairs were also made right into the 20th century in many parts of the world. Pictured at left is a chair that most likely stems from northern New England or Atlantic Canada. It's made of birch and was found in a Massachusetts antiques fair. It features through-mortises all around. Sometimes the rungs are then wedged from outside the chair's posts to tighten them up. That's usually done at assembly, but maybe sometimes the wedging is a later repair. I've seen some examples where some mortises came through the posts and some did not. In that case, the through-mortise is usually figured to be a mistake. The period ones I have seen have flat back slats, rather than bent and curved.

***At the horse.*** *To shave chair parts, I hold the workpiece in a shaving horse, then use a drawknife to shape the parts and a spokeshave for forming the finished tenons.*

## Tools & Techniques

Small, simple and effective are words to describe these chairs. You can make one with a handful of tools: splitting tools, a drawknife, a brace and bit and not much else. A knife, perhaps, for final trimming of the tenons. A narrow chisel for the slat mortises.

I prefer to make them with ash rungs and maple posts, and slats of riven oak. But I will substitute most any local hardwood that I can split for this. Except, that is, for the posts. When I am making one that is intended to represent an historical example, I never use oak for the posts. That's because I have never seen a period chair made during the 16th and 17th centuries with shaved or turned oak posts. Earlier, yes. Later, yes. In the middle, no. Oak is joiner's wood.

You can alter the angles of the side rungs to the rear posts to make the chair's back lean back some, or you can hew a "cant" into the rear posts' side view prior to shaving them. Dead-straight upright rear posts are unpleasant.

This period chair, though, was not steam-bent like its modern counterparts. Alexander's chairs, and their descendants, are modern adaptations of the 17th-century plain matted chair. And there are improvements galore in the descendants: more comfort, lighter weight, stronger joints, all-around better made. I hope to make one soon.

***Mortises.*** *I used an auger bit this time, though a spoon bit is the "traditional" tool for an earlier period. I lined up both posts side-by-side to bore the mortises. You can do without a ruler; just scribe lines across both posts and start boring.*

Whatever you call this form of chair, it's hard to exaggerate its importance in the history of seating furniture. Every culture that uses chairs has this type, be it more or less pronounced. Meanwhile, I'm still called on sometimes to make an historical example, and I rough them out. Fun stuff, but the London turners have no sway over me – I can make whatever I want. **PWM**

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*Peter has been involved in traditional craft since 1980. Read more from him on spoon carving, period tools and more at pfollansbee.wordpress.com.*

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## About this Column

ARTS & Mysteries

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# The Solution to Finish Problems?

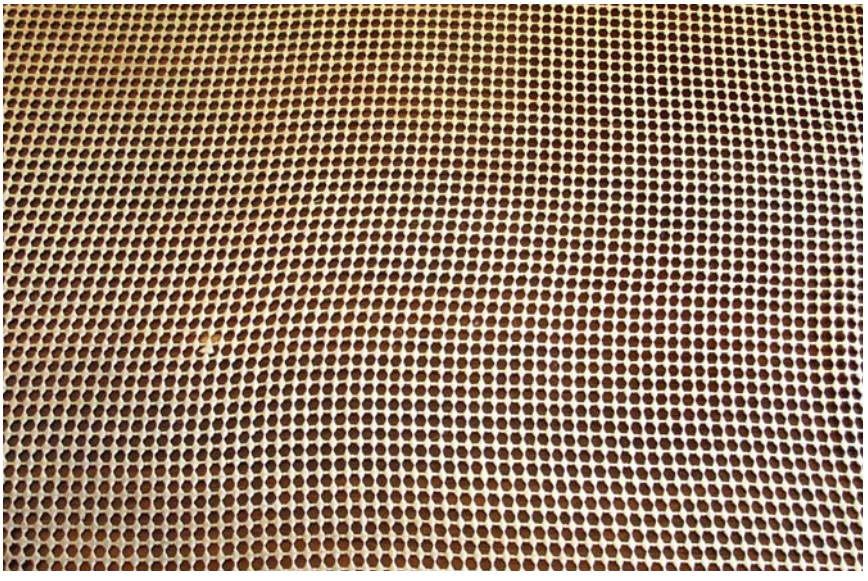
## A combination of knowledge and experience.

All sorts of damage can occur to a finish. I've written about the most common problems and how to fix them many times. Four of the articles I wrote for *Popular Woodworking* are included in my book, "Flexner on Finishing" (Popular Woodworking).

These articles deal with problems such as water rings, rubs and scrapes, magic-marker and crayon marks, dripped candle wax and more. It's good to know how to fix these problems, but there are so many other things that can happen – many so unusual that you'll never find instructions for fixing them.

In these situations you have no choice but to come up with the fix yourself. Your ability to do this improves with experience, of course, but most important is a good basic knowledge of finishes and solvents so you don't cause more damage.

This knowledge isn't difficult. It comes down to the way you organize and define the finishes and solvents.



***Floor mat.*** *This type of floor mat partially dissolved and stuck to a wooden floor in my son's house. How could I remove the hardened fragments without damaging the finish?*

### Finishes

Most important for understanding finishes is knowing how they dry or cure.

Oil-based varnish (including polyurethane varnish), catalyzed finishes and drying oils, such as linseed oil, tung oil and oil/varnish blend, cure by crosslinking. They can't be redissolved with their solvent, but they can sometimes be damaged by extended contact with strong solvents such as acetone and lacquer thinner.

Lacquer, shellac and wax dry simply by the evaporation of their solvent. They can then be redissolved with their solvent at any time.

Water-based finishes are unique. They dry partly by crosslinking and partly by the evaporation of water and a slow-evaporating solvent. Some brands are susceptible to being damaged by many solvents, including alcohol, xylene, toluene, lacquer thinner and acetone. Other brands are resistant to one or more of these solvents.

### Solvents

There are several families of solvents typically available at paint stores and home centers.

The petroleum-distillate family includes, from weakest to strongest, mineral spirits (paint thinner), naphtha, xylene and toluene. The ketone family includes acetone and methyl ethyl ketone (MEK). The only alcohol still widely available is denatured alcohol.

Lacquer thinner is a combination of as many as six solvents, the most important of which, for our purposes, being acetone and other similar solvents that dissolve lacquer.

Here's how I put this knowledge to use in a real situation that I encountered recently at my son's house.

### The Problem & Fix

A toilet overflowed and soaked the floor in a nearby room causing the floor mat (under the rug) to become stuck to the wood. When pulled up, pieces of the mat stuck to the floor and became very hard as they dried out. The challenge was to remove these pieces without damaging the finish on the floor.

Here's how my thinking went.

The dried pieces were very hard. I first considered abrading them off, but it would be difficult to avoid leaving scratches in the gloss, water-based, polyurethane finish, and abrading might cut through the finish and some of the stain underneath. This risk was especially great at the raised ridges where the slightly cupped floorboards joined. So I ruled out this solution.

But not entirely. I could also abrade carefully and apply another coat of water-based finish on top to hide the scratches. But I didn't want to do this because it would involve removing

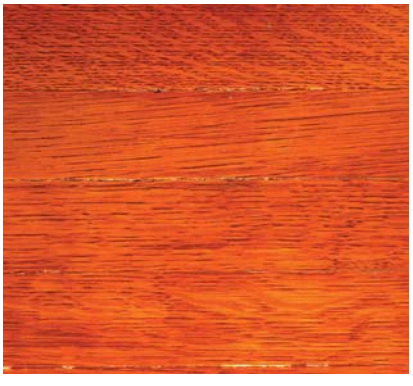


PHOTOS BY THE AUTHOR

***Particles stuck to floor.*** *Here is a small section of the floor showing particles of the floor mat stuck to the finish. The particles dried very hard.*

***Scraping softened particles.*** *Wetting small sections of the floor for several minutes at a time using a water-dampened cloth softened the particles enough that I could scrape them off using a credit-type card. This method worked, but it was very slow.*

***Cleaning with alcohol.*** *In an attempt to find a faster method of removing the dried floor-mat particles, I tried rubbing with denatured alcohol after checking that this solvent wouldn't damage the finish. It worked much faster.*



***Problem solved.*** *Here's a section of the floor with the floor-mat particles completely cleaned off. No damage was done to the water-based finish.*

all the furniture and disrupting the household.

Because the finish was water-based polyurethane rather than oil-based polyurethane, my options using a solvent to remove the mat particles were limited. Many solvents damage water-based polyurethane that don't damage oil-based polyurethane.

So I quickly ruled out trying the solvents that would most likely dissolve the mat particles because they would also likely damage the finish. These included the common solvents acetone, lacquer thinner, xylene, toluene and alcohol. Mineral spirits and naphtha wouldn't cause any harm to the finish if used sparingly, but I really doubted they would dissolve the particles.

I reasoned that if water had caused the problem, maybe I could use it to soften the particles enough to scrape them off the floor. I began soaking small sections of the floor with wet rags, being careful not to overdo it and cause the finish to peel. After a few minutes the particles turned white.

Then I scraped off the softened particles with a plastic credit-type card. This worked well, but it was too slow for an 8' x 10' area. I needed to come up with a faster way.

Alcohol is the mildest of the solvents I had ruled out. I knew from experience that it softens and dulls most water-based finishes. But water-based finishes are formulated differently, so it was worth a try on a small, somewhat-hidden area to find out what would happen.

I wetted a cloth with denatured alcohol and began rubbing in the most inconspicuous part of the floor. I watched closely what was happening, including trying to dig my fingernail into the finish to see if the alcohol had softened it. It had a little but not enough to cause a smear, and the finish didn't dull.

So this was a faster way. I removed all the mat particles within two hours.

## Lessons

Notice several points about this situation and my approach to it.

First, I had never seen this problem before, and I doubted there were many others who had seen it either.

Second, I began ruling out possible solutions for various reasons, the most important being that I wanted to remove the mat particles without damaging the finish. I used my knowledge of finishes and solvents to eliminate many of the solvents that I suspected would remove the mat particles, but would also likely damage the water-based finish. I didn't have to try each.

Third, I tried one possible solution and found that it worked. But it was slow, so I searched for a faster method. Here, I had to carefully try a solvent to find out if it would dissolve the particles, and to learn how resistant the finish would be.

So a combination of basic knowledge and a little trial-and-error solved the problem. **PWM**

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*Bob is author of "Flexner on Finishing," "Wood Finishing 101" and "Understanding Wood Finishing."*

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# World's Best-known Tool Cabinet

## Decoding the mystery of piano and organ maker Henry O. Studley.

The amazing tool cabinet of piano-maker Henry O. Studley has fostered intense admiration and contemplation surrounding its origins and creator for nearly three decades. I've heard a lot of this speculation while conducting research for the book "Virtuoso: The Tool Cabinet and Workbench of Henry O. Studley" (Lost Art Press). About the only thing I've not heard is that Studley's creative genius was proof of extraterrestrial visitation.

The reality is both inspiring and mundane.

**Who?** Studley was born in 1838 in Lowell, Mass., into a family of skilled tradesmen; he died in Quincy, Mass., in 1925. As a young man he mastered the cabinetmaking trade and worked nearly his entire adult life in the precision woodworking world of organ and piano building. The only known portrait of Studley presents him at the top of the piano-factory food chain.

**What?** His tool cabinet, filled with in many cases customized tools, and his workbench, were fabricated from premium mahogany. The cabinet is enhanced with ebony details and hundreds of ivory and mother-of-pearl inlays. The workbench top is laminated from mahogany faces on an oak core, and features two amazing vises.

**When?** Studley's obituary states that the tool cabinet was constructed during his circa 1898-1919 tenure at the Poole Piano Company. I don't (yet) know whether he built it in his free time or on company time, or how long it took.

**Where?** While there is no way to know where he built the cabinet and workbench, there is no record of a home shop; "the factory" is the likely answer.

**How?** This one is easy: with consummate skill. All the workmanship is crisp and confident, and the composition and detailing demonstrate genuine inspiration. Clearly the cabinet was constructed specifically for the tools it houses, with all the spatial and aesthetic details resolved prior to starting.

**Why?** I believe it is fair to conclude that Studley was simply showing off a lifetime's acquisition of skill and tools. And given the skills evident in the cabinet's design and execution, he had much to show off about.

In 2010, my inquiries about the tool cabinet led to a phone call from its owner, who invited me to visit and examine the cabinet and workbench. The rest, as they say, is history. The result is the book "Virtuoso" and the first-ever exhibit of the cabinet and workbench together, May 15-17, 2015, in Cedar Rapids, Iowa.

And yet, there is much left to learn about this enigmatic genius. PWM

*Don is a furniture and decorative arts conservator and author of "Virtuoso: The Tool Cabinet and Workbench of Henry O. Studley (Lost Art Press). His web site is donsbarn.com.*

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